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November 13, 1995

Jeanne Griffin
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, IL 60604

Subject: **Site Evaluation Report**
U.S. Army Jefferson Proving Ground
Madison, Indiana
EPA ID No. IN5 210 020 454
Contract No. 68-W8-0084, Work Assignment No. 58-5JZZ

Dear Ms. Griffin:

PRC Environmental Management, Inc. (PRC), has prepared the enclosed site evaluation report for the above-referenced site (Enclosure 1). PRC reviewed available information and prepared a preliminary Hazard Ranking System (HRS) score for U.S. Army Jefferson Proving Ground (JPG). Based on PRC's findings, the preliminary HRS score for this site is greater than 28.50. This score only reflects relative risks to human health and the environment for sources located south of the Firing Line. Although the area north of the Firing Line contains significant amounts of unexploded ordnance, evaluation of this area has been deferred because insufficient information is available.

The primary concern at JPG is the contamination of surface water. The other HRS pathways were not evaluated because of lack of analytical data or because the number of targets was minimal.

The U.S. Environmental Protection Agency recommendation form is included in Enclosure 2. The preliminary HRS score for JPG is documented in a transmittal memorandum and preliminary scoresheets in Enclosure 3. If you have any questions, please call me at (312) 946-6476.

Sincerely,

Sandy Anagnostopoulos
PRC Project Manager

Enclosures (3)

cc: Thomas Short, EPA Project Officer (letter only)
Brigitte Manzke, EPA Contracting Officer (letter only)
Majid Chaudhry, PRC Program Manager (letter only)

ENCLOSURE 1

SITE EVALUATION REPORT

U.S. ARMY JEFFERSON PROVING GROUND
MADISON, INDIANA
EPA ID NO. IN5 210 020 454

SITE EVALUATION REPORT

U.S. ARMY JEFFERSON PROVING GROUND
MADISON, INDIANA

EPA ID NO. IN5 210 020 454

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Site Assessment Section
77 West Jackson Boulevard
Chicago, IL 60604

EPA Work Assignment No.	:	58-5JZZ
EPA Region	:	5
Date Prepared	:	November 13, 1995
Contract No.	:	68-W8-0084
PRC Project No.	:	030-0058030303
Prepared by	:	PRC Environmental Management, Inc. (Dana Mun)
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CONTENTS

FIGURES

1.0 INTRODUCTION

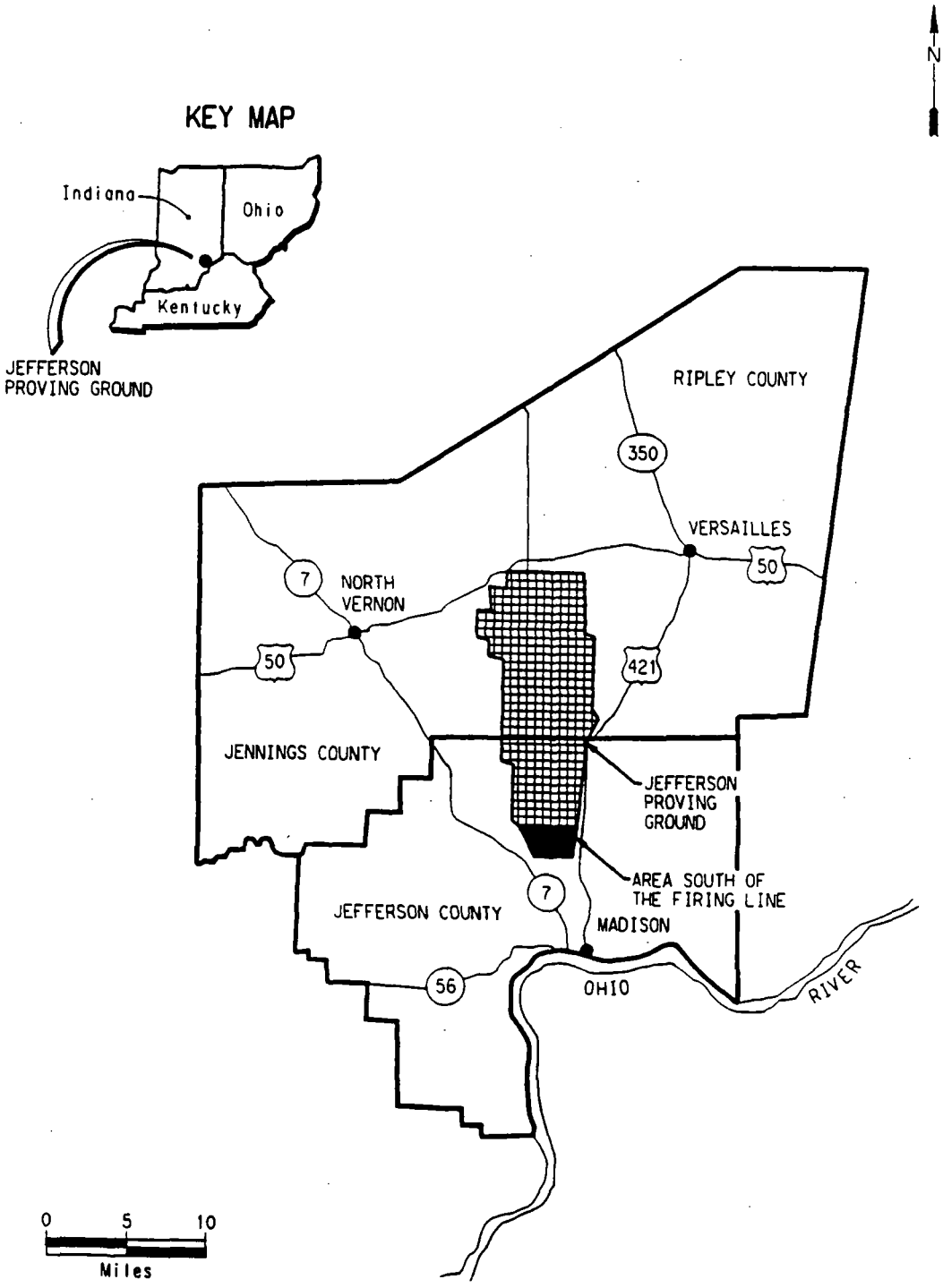
Under Contract No. 68-W8-0084, Work Assignment No. 58-5JZZ, PRC Environmental Management, Inc. (PRC), has evaluated the U.S. Army Jefferson Proving Ground (JPG) site in Madison, Indiana, as a potential candidate for the National Priorities List (NPL) and has prepared this draft site evaluation report. Using the Hazard Ranking System (HRS), PRC evaluated the site to determine whether, or to what extent, it poses a threat to human health and the environment. This report presents the results of PRC's evaluation and summarizes the site conditions and targets pertinent to the migration and exposure pathways associated with the JPG site.

Most of the information used to identify potential sources and evaluate the site was obtained from the following documents: a final draft remedial investigation (RI) report; a Resource Conservation and Recovery Act (RCRA) Part B permit application, an installation assessment report, a preliminary site inspection report, and an enhanced preliminary assessment report. Additional information on JPG was found in a master environmental plan, an environmental audit report, and other types of environmental investigation reports.

This report has six sections, including this introduction. Section 2.0 describes the JPG site. Section 3.0 discusses site operations and history. Section 4.0 describes each source associated with the site that is being evaluated. Section 5.0 provides information about the four migration and exposure pathways (groundwater migration, surface water migration, soil exposure, and air migration) that can be scored. Section 6.0 summarizes conditions at the site. A list of references used in preparing this report appears at the end of the text.

2.0 SITE DESCRIPTION

The JPG site occupies about 55,265 acres in rural Jefferson, Jennings, and Ripley Counties in southeastern Indiana. The site is about 18 miles long from north to south and 3 to 6 miles wide from east to west (Ref. 10, Vol. I, p. 1-2). The site is located along U.S. Highway 421, 6 to 9 miles north of the city of Madison. The site lies about 45 miles northeast of Louisville, Kentucky, and 75 miles southwest of Cincinnati, Ohio (Ref. 6, Vol. I, p. B-1). The latitude and longitude of JPG are 38° 50' 00" north and 85° 24' 50" west, respectively (Ref. 1, p. 1). The predominant land use within 1 mile of the site is agricultural (Ref. 19, p. 1; Ref. 20). Figure 1 shows the location of the site.



Source: Reproduced from U.S. Army Environmental Center. 1994. "Final Draft *Remedial Investigation.*" Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

U.S. Army Jefferson Proving Ground
Madison, IN

Figure 1
Site Location Map

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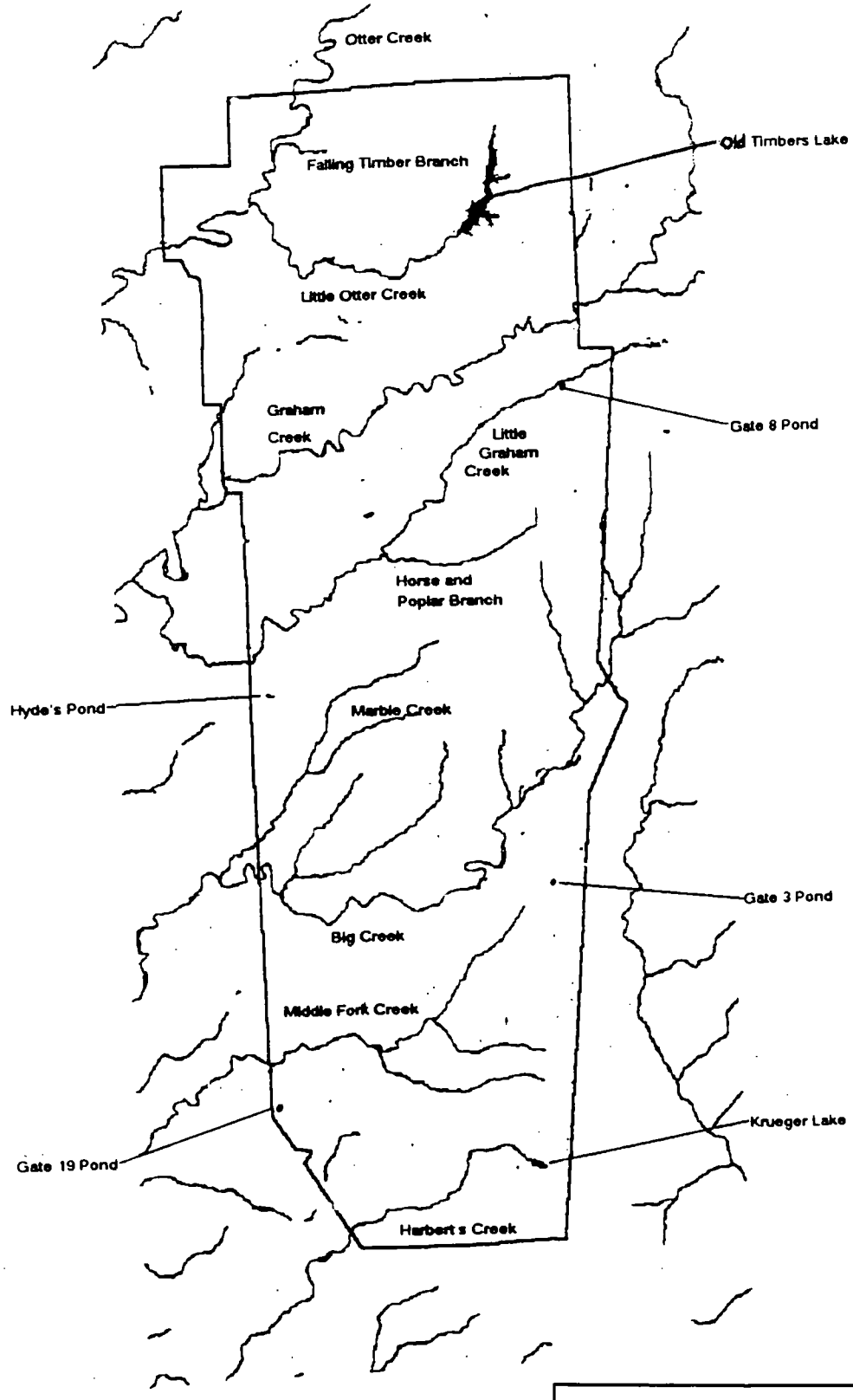
The topography of the southern two-thirds of JPG is flat, and the topography of the northern third is gently rolling. The surface of JPG slopes gently from east to west with elevations along the eastern boundary varying from 281 to 285 meters (about 0.18 miles) above mean sea level (msl); elevations along the western boundary vary from 253 to 258 meters (about 0.16 miles) above msl (Ref. 16, p. 6-7). Many scattered, small ponds and several lakes are present at JPG. Six major, parallel creeks flowing generally to the west-southwest dissect JPG, as shown in Figure 2.

A total of 481 buildings are located throughout JPG. The site contains 50 impact areas, 13 permanent test complexes, and seven ammunition assembly plants. A line of 268 gun positions runs from east to west across JPG about 2 miles from the site's southern boundary (see Figure 1). Weapons are fired at targets located north of these gun positions. The immediate area of the gun positions is referred to as the Firing Line. JPG is divided into two distinct functional areas by the Firing Line: the northern impact areas and the southern cantonment area (Ref. 10, Vol. I, p. 1-2).

Most of the 50 impact areas, which cover at least 8,600 acres, are located north of the Firing Line (Ref. 3, p. 48). These impact areas include high-impact targets, asphalt- and sediment-bottom ponds for testing proximity fuzes, a gunnery range, mine fields, and a depleted uranium (DU) impact area (Ref. 10, Vol. I, p. 1-6). Unexploded ordnance (UXO) is common to all areas of JPG, especially from the Firing Line to the northern border of the impact areas (Ref. 16, p. 13). Surrounding the impact areas are safety fans where wide, long, or short rounds may fall. These areas all contain UXO. The impact areas are kept clear of vegetation by continual disc plowing and infrequent herbicide application (Ref. 10, Vol. I, p. 1-6).

Industrial buildings, workshops, administrative buildings, and personnel housing are located in the cantonment area south of the Firing Line. Photographic laboratory, paint shops, vehicle and weapon maintenance areas, artillery and ammunition storage areas, and radar facilities are also located in this part of JPG (Ref. 18, p. 4). Fifty potential sources of hazardous substances have been identified south of the Firing Line at JPG. These sources include burning grounds and detonation areas, landfills, solvent disposal pits, sludge disposal areas, waste storage areas, and a mine testing area (Ref. 10, Vol. I, p. ES-1 and Table ES-1, pp. ES-6 to ES-10).



U.S. Army Jefferson Proving Ground
Madison, IN

Figure 2
Locations of Major Lakes, Ponds, and Creeks at JPG

PRC ENVIRONMENTAL MANAGEMENT, INC.

Source: Modified from U.S. Fish and Wildlife Service. 1994. "Jefferson Proving Ground Fish and Wildlife Management Plan." September.

3.0 SITE OPERATIONS AND HISTORY

JPG is a proving ground owned by the U.S. Army Testing and Evaluation Command. JPG's mission has been to plan and conduct production acceptance tests, reconditioning tests, surveillance tests, and other studies of ammunition and weapons systems (Ref. 1, p. 3). A wide assortment of conventional munitions and weapons have been tested at JPG. These include propellants, projectiles, cartridges, mortars, grenades, fuzes, primers, boosters, rockets, tank ammunition, mines, and weapon components. Past and present activities at JPG have included detonation, burning, and disposal of many types of waste propellants, explosives, and pyrotechnic substances (Ref. 10, Vol. I, p. 1-5).

JPG has had three active periods: World War II, the Korean War, and the Vietnam War. In December 1940, the construction of JPG began in order to support munitions testing activities. The first round was tested in May 1941, but testing activities were sharply reduced at the end of World War II. In March 1946, JPG became a subpost of the Indiana Arsenal instead of an independent command (Ref. 3, p. 11).

The outbreak of the Korean War resulted in JPG being reactivated in June 1950. Between 1951 and 1955, additional structures such as test firing and storage facilities were constructed at the site. During this period, JPG focused on special production engineering tests as well as research and development tests. The end of the Korean War resulted in decreased testing activities at JPG. In July 1958, JPG was placed on standby status, but its ammunition test capabilities were maintained at a high level of readiness (Ref. 3, p. 11). JPG was partially reactivated in 1961 because of the Berlin Crisis (Ref. 7, p. 4).

Testing activities resumed at JPG in the early 1960s because of the Vietnam War. From the end of the Vietnam War until the recent period of preparation for the planned base closure, JPG has continued to test munitions, although at a lower frequency than during wartime (Ref. 6, Vol. I, p. B-2; Ref. 7, p. 4; Ref. 10, Vol. I, p. 1-1). JPG currently has about two military and 365 civilian employees (Ref. 6, Vol. I, p. B-1). The peak employment at JPG was 1,774 in 1953 (Ref. 7, p. 6).

Testing and standby operations at JPG have involved a variety of waste management practices, including disposal, storage, and treatment of hazardous waste. Methods of hazardous waste disposal used at JPG have included open burning and open detonation (OB/OD), incineration, landfilling, disposal of solvents in pits, and application of contaminated sludge to surface soil. General categories

of wastes disposed of at the site have included materials contaminated with propellants, explosives, and solvents; untreated industrial wastewater; and construction rubble (Ref. 1, p. 4; Ref. 13, Appendix D; Ref. 10, Vol. I, p. ES-1).

Facility support buildings at JPG use or have used, a variety of oils, solvents, lubricants, and other process materials. The associated wastes are routinely collected and stored until their on-site or off-site disposal (Ref. 10, Vol. I, p. 14-2). Temporary and long-term waste storage areas at JPG include Defense Reutilization and Marketing Office (DRMO) storage areas, drum storage pads, and storage buildings (Ref. 10, Vol. I, pp. ES-1, 14-2, 22-1, 23-1, 26-1, and 28-1). Materials stored in these areas include pesticides and herbicides, polychlorinated biphenyl (PCB) contaminated oil, paint waste, waste solvents, asbestos, and ash (Ref. 10, Vol. I, pp. 22-1, 23-1, and 28-1).

Treatment facilities at JPG include a Sewage Treatment Plant (STP) that receives wastewater from the photographic laboratory, boiler plant, and sanitary sewer. The treatment system consists of a settling tank (Imhoff tank), sludge-drying beds, and a trickling filter system, in which the processed water is recirculated several times before its discharge through a national pollutant discharge elimination system (NPDES) permitted outfall to Harberts Creek. The permit was recently renewed by the State of Indiana (Ref. 10, Vol. I, p. 1-20).

JPG also requires a RCRA Part A interim permit because pyrotechnics, explosives, and propellants are stored and thermally treated on site. These items are also detonated on open ground. A RCRA Part B permit application and its revision for the OB/OD units were submitted to U.S. Environmental Protection Agency (EPA) Region 5 in November 1988 and February 1993, respectively. In addition, an open burning permit from the Indiana Department of Environmental Management (IDEM) is required for JPG to burn excess propellants, explosives, vegetation, and scrap wood. This permit is renewed annually (Ref. 10, Vol. I, p. 1-20). Because the RCRA Part B permit application was submitted for both open burning and detonation units, the annual IDEM permit will not be required upon the approval of the RCRA Part B permit application (Ref. 3, p. 14).

JPG is currently undergoing closure based on a recommendation made by the Base Realignment and Closure (BRAC) Commission in December 1988. The BRAC Commission recommended relocation of JPG product acceptance testing activities to the Yuma Proving Ground in Arizona. Under the guidelines of the base closure plan for JPG, testing activities were scheduled to stop by 1994, and land disposition was to be accomplished by 1995 (Ref. 6, Vol. I, p. B-2). Appropriate cleanup and

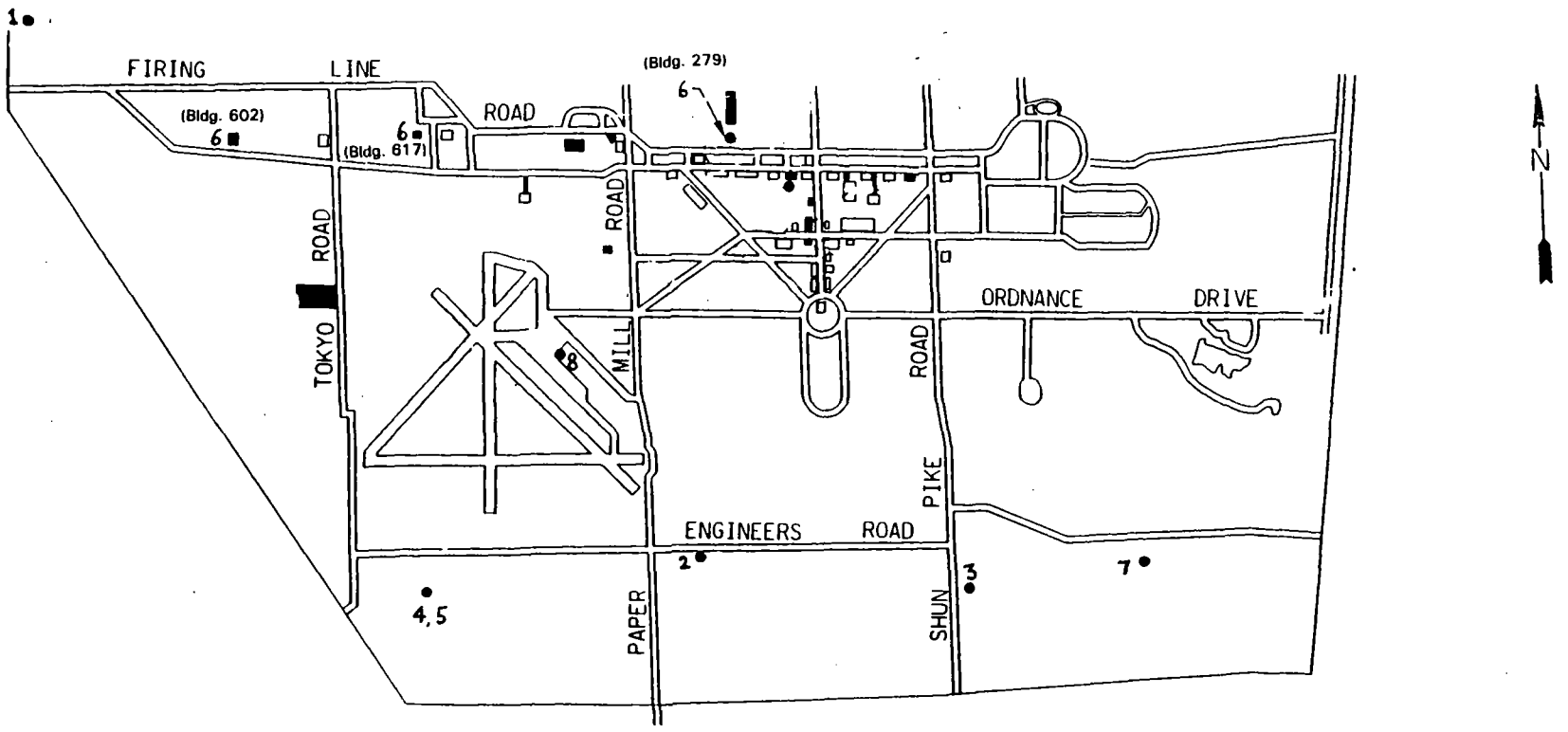
reuse of the site are being expedited in accordance with President Clinton's July 2, 1993, five-point program. This program calls for establishing cleanup teams to conduct "bottom-up" reviews of cleanup plans and schedules, accelerating the National Environmental Policy Act (NEPA) process, involving the public, preparing suitability to lease documentation, and implementing the Community Environmental Response Facilitation Act (CERFA) for identification of uncontaminated real estate. In support of the BRAC process at JPG, the U.S. Army proposed and is currently implementing an RI and feasibility study (FS) to evaluate the area south of the Firing Line and recommend cleanup activities as required. Initiation of RI/FS activities north of the Firing Line was deferred pending more definitive land reuse planning (Ref. 10, Vol. I, p. 1-1).

4.0 SOURCE DESCRIPTIONS

Eight of the 50 sources identified at JPG were considered in the HRS evaluation of the site. Sample analytical data are available for only 38 of the sources identified at JPG, and at 30 of these sources, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances either were not detected or were detected at minimal concentrations compared to those at the eight sources selected for evaluation. The eight sources evaluated have been documented as containing CERCLA hazardous substances, and extensive sample analytical data are available for these sources.

The area north of the Firing Line contains significant amounts of UXO; however, its complete evaluation has been deferred because insufficient information is available. About 8,600 acres of JPG has been used as designated impact or target areas, and about 51,700 acres of JPG is suspected of being contaminated with UXO (Ref. 3, p. 48).

This section describes the eight sources evaluated at the JPG site. The following information is presented for each source: a source description; dates of associated operations, and releases, as applicable; and a summary of associated sampling activities. The locations of the sources evaluated for JPG are shown in Figure 3.



Source Names

1. Gate 19 Landfill
2. Abandoned Landfill
3. Burning Area for Explosive Residue
4. Sewage Treatment Plant
5. Sewage Sludge Application Areas
6. Solvent Disposal Pits Associated with Buildings 279, 602, and 617
7. Gator Z Mine Test Area
8. Building 305 Temporary Waste Storage Area

U.S. Army Jefferson Proving Ground
Madison, IN

Figure 3
Enlarged View of Source Locations

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Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

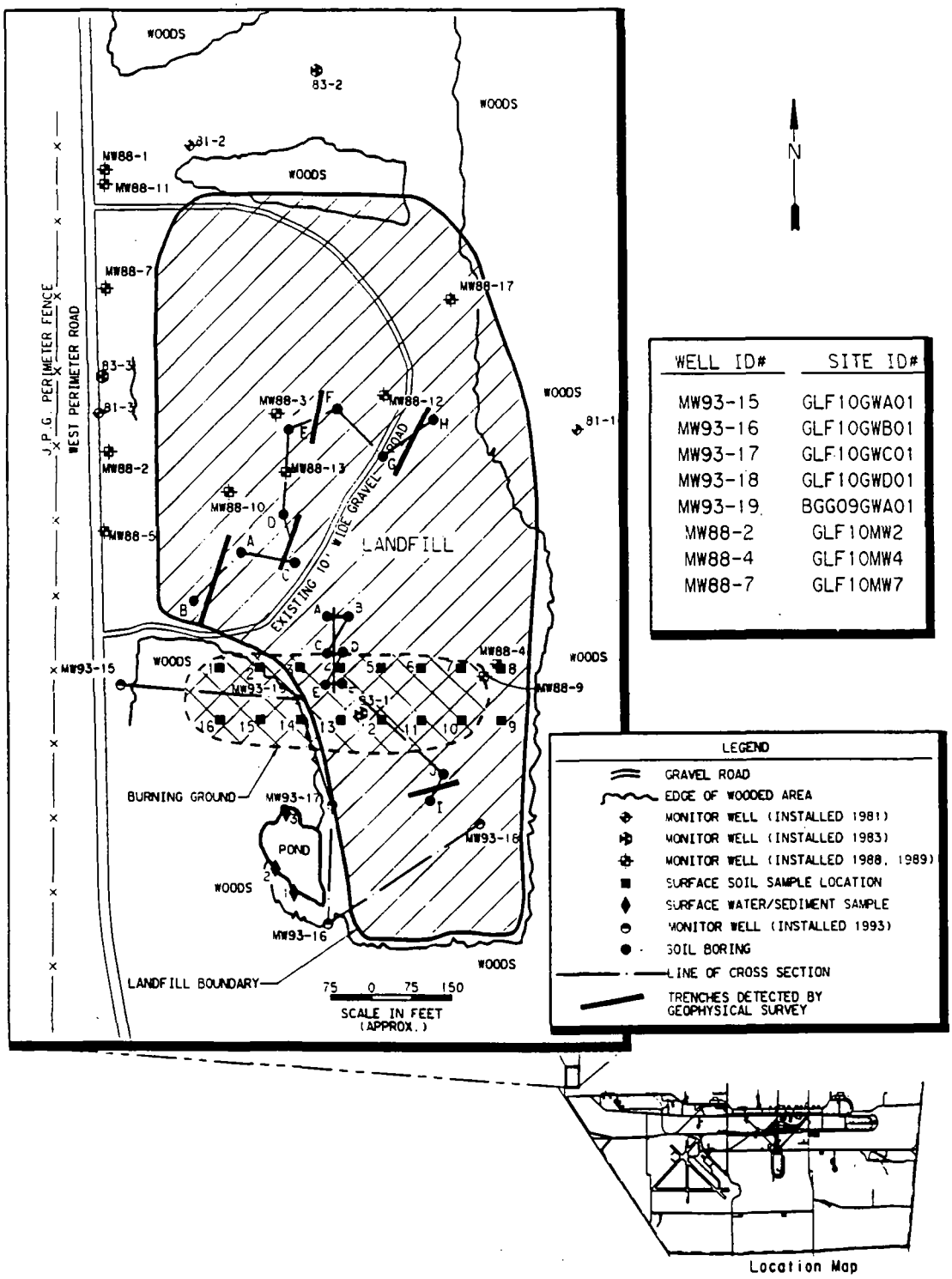
4.1 GATE 19 LANDFILL

Source Description:

The 12-acre Gate 19 Landfill (Source 1) is located at the far western end of the Firing Line north of the intersection of Firing Line Road and West Perimeter Road. Figure 4 shows sampling locations for Source 1. According to a 1993 revised preliminary site inspection report, the boundary of the landfill varies slightly from that shown in Figure 4 in that the boundary on the southwestern side extends to include the adjacent pond (Gate 19 pond) (Ref. 1, p. 29). The landfill is covered by a thick growth of grass and perennial vegetation. The landfill area is bounded on the north, east, and south sides by dense woods and on the west side by West Perimeter Road. The landfill area is flat to gently rolling, and most surface water runoff appears to flow toward Gate 19 pond at the southwestern corner of the area. This pond also receives runoff from a ditch that flows west along Firing Line Road. According to JPG personnel, the pond is an abandoned rock quarry that predates JPG. The pond, which was once stocked with fish and used as a recreational fishery, was found to be contaminated. An outlet from the pond drains to the west and runs through open farmland before entering Middle Fork Creek about ¼ mile west of the JPG boundary. Along the northern half of the landfill, surface runoff flows directly to Middle Fork Creek (Ref. 10, Vol. I, p. 10-1).

The Gate 19 Landfill consists of an asbestos disposal area (about 2 acres) and a waste pile of construction debris (about 10 acres). There is no indication that the landfill was lined with an impermeable layer. Asbestos has been disposed of in the northwestern corner of the landfill and along the western side away from the construction debris. Asbestos wastes are currently double-bagged and buried in the disposal area; however, the disposal method used in the past is unknown. The construction debris reportedly consists mainly of concrete block, metal, wire, and a minor amount of wood debris, all of which was deposited on the ground surface. Other trash and debris have reportedly been disposed of in shallow trenches located throughout the landfill; however, the shapes and sizes of the trenches are unknown. The trenches reportedly received noncombustible trash and incinerator ash (Ref. 10, Vol. I, p. 10-1).

At one time, the landfill reportedly received lead paint and methylene chloride and polyurethane residues generated from inert loading activities. According to several investigation reports, between 1960 and 1980, the landfill also received 1,000 to 10,000 gallons of trichloroethylene (TCE) and paint (Ref. 10, Vol. I, p. 10-1). Also, unrinsed pesticide containers have reportedly been disposed of at the landfill (Ref. 16, p. 30). Burning of hazardous wastes is also known to have occurred in the landfill area (Ref. 10, Vol. I, p. 10-1).



Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

U.S. Army Jefferson Proving Ground
Madison, IN

Figure 4
Gate 19 Landfill (Source 1)

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A water level investigation of the source area indicated that the depth to groundwater ranges from 4 to 10 feet below ground surface (bgs) and that shallow groundwater flows to the west-northwest toward Middle Fork Creek (Ref. 10, Vol. I, p. 10-2).

Dates of Operation and Releases:

The landfill has been used since 1960. However, during a 1993 RI, disposal of waste at the landfill was restricted because JPG was planning for landfill closure. The landfill was closed in October 1993 (Ref. 10, Vol. I, p. 10-1).

Sampling Activities:

Analysis of surface soil samples collected from the Gate 19 Landfill area during the 1993 RI revealed the presence of semivolatile organic compounds (SVOC) and elevated concentrations of heavy metals. SVOCs detected included acenaphthene, benzo(a)anthracene, chrysene, fluorene, and phenanthrene. Metals present at elevated concentrations included barium, copper, and lead. No volatile organic compounds (VOC) were detected in the surface soil samples (Ref. 10, Vol. I, Table 10-1 and Figure 10-1).

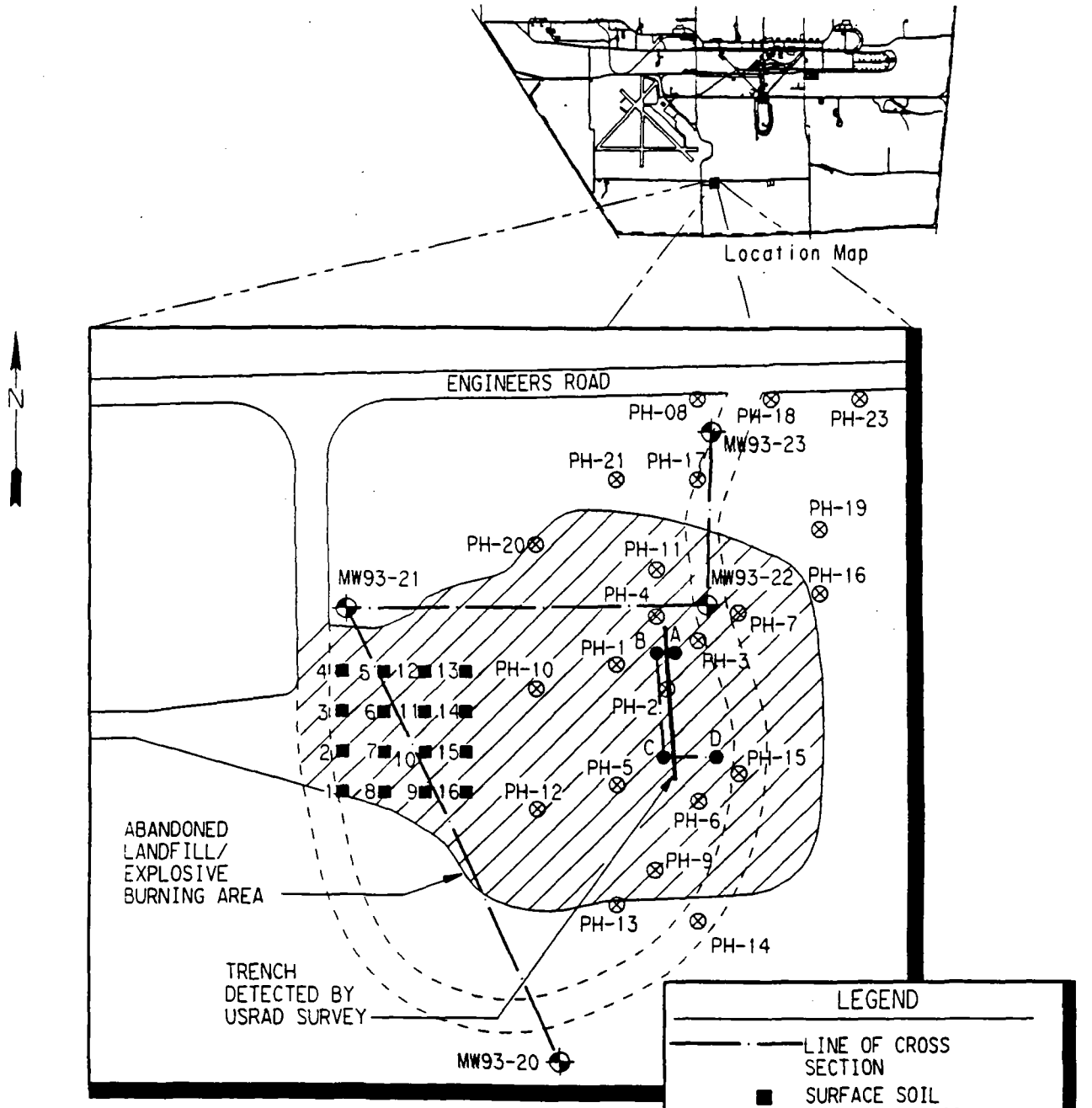
Analysis of subsurface soil samples collected in the source area during the 1993 RI revealed elevated concentrations of arsenic, barium, copper, lead, nickel, mercury, silver, and zinc. SVOCs such as acenaphthene, anthracene, benzo(a)anthracene, 3,4-benzofluoranthene, chrysene, fluorene, and phenanthrene were also detected in the subsurface soil samples. VOCs detected included benzene, TCE, 1,1-dichloroethene (1,1-DCE), and toluene (Ref. 10, Vol. I, pp. 10-7 and 10-8, Table 10-1 and Figure 10-1).

Since 1981, a total of 24 groundwater wells have been installed and monitored in the source area. Hazardous substances detected in the groundwater wells include benzene, chloroform, methylene chloride, trichloroethane (TCA), TCE, trichlorofluoromethane, and toluene (Ref. 12; Ref. 5, p. 1-7).

4.2 ABANDONED LANDFILL

Source Description:

The 1-acre Abandoned Landfill (Source 2) is located south of Engineers Road and east of Papermill Road in the south-central part of the cantonment area at JPG. Figure 5 shows sampling locations for Source 2 used during the 1993 RI. The land surface in the source area slopes to the northeast toward a branch of Harberts Creek that is located about 300 feet north of Engineers Road. Relatively young woods surround the open source area on the eastern, northern, and western sides; the southern side connects with a large, open area that seems to have been an agricultural field. The specific locations of the landfill trenches were not readily discernible during the initial 1993 RI site visit, but follow-up magnetometry and electromagnetic



WELL #	SITE ID #
MW93-20	ALF04GWA01
MW93-21	ALF04GWB01
MW93-22	ALF04GWC01
MW93-23	ALF04GWD01

Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

U.S. Army Jefferson Proving Ground
Madison, IN

Figure 5
Abandoned Landfill (Source 2)

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conductivity surveys were used to delineate the location of a buried trench within the landfill (Ref. 10, Vol. I, pp. 6-1 and 6-3). An open burning area was apparently located next to the landfill trench, as burned film canisters were observed around the landfill area (Ref. 10, Vol. I, p. 6-1).

The landfill is made up of filled-in trenches. The landfill reportedly was used as a dumping ground for film refuse from the photographic laboratory. The waste materials included waste acetate-based photographic film that likely contained silver and cyanide. In addition, pesticide containers, ash from incineration of small arms ammunition, and paint wastes were likely disposed of in this landfill because it reportedly was the only JPG landfill in operation between 1941 and the early 1960s. Also, spent solvents reportedly were disposed of in the landfill (Ref. 10, Vol. I, p. 6-1).

A water level investigation of the source area indicated that the depth to groundwater ranges from 5 to 19 feet bgs (Ref. 10, Vol. I, p. 6-2).

Dates of Operation and Releases:

The landfill reportedly was used from 1941 to 1970, primarily as a dumping ground for film refuse from the photographic laboratory (Ref. 10, Vol. I, p. 6-1).

Sampling Activities:

Analysis of surface soil samples collected from the source area during the 1993 RI revealed elevated concentrations of heavy metals such as barium, copper, nickel, and zinc. These samples were not analyzed for VOCs or SVOCs. None of the samples contained explosive chemicals (Ref. 10, Vol. I, pp. 6-4 and 6-5, Table 6-1, Figs. 6-1, 6-4, 6-5, and 6-6).

Analysis of subsurface soil samples collected from the source area during the 1993 RI revealed the presence of one VOC, SVOCs, and elevated concentrations of heavy metals. TCE was the only VOC detected. SVOCs such as dimethyl phthalate, di-n-butylphthalate, and benzylalcohol were detected. Metals present at elevated concentrations included barium, copper, lead, silver, and zinc. (Ref. 10, Vol. I, Table 6-1, Figs. 6-1, 6-4, 6-5, and 6-6).

Acetone was detected in one of four monitoring wells (MW) installed in the source area during the 1993 RI, and two of the MWs contained SVOC contamination. SVOCs detected included 2-chlorophenol, naphthalene, and 1,4-oxathiane; however, more SVOCs were detected in a MW (MW93-23) that appears to be upgradient of the landfill (Ref. 10, Vol. I, p. 6-7, Table 6-1, Figs. 6-1, 6-4, 6-5, and 6-6).

4.3 BURNING AREA FOR EXPLOSIVE RESIDUE

Source Description:

The Burning Area for Explosive Residue (Source 3) is active and is RCRA-regulated. A RCRA Part B permit application was submitted for this area in November 1988, and a revised application was submitted in February 1993.

This source area is located in the southeastern part of the cantonment area just east of Shun Pike Road. Figure 6 shows Source 3 sampling locations. The 40,000-square foot burning area is flat to gently rolling. The surface slopes gently to the north toward a branch of Harberts Creek that is located about 1,200 feet away. Woods lie to the north, east, and south of the source area, and Shun Pike Road forms its western boundary (Ref. 10, Vol. I, p. 11-1).

About 60,000 pounds of excess propellant per year has been burned in the open in this source area since the early 1950s. Before 1986, the open burning was conducted on the ground surface (Ref. 18, p. 62). Currently, the burning is conducted in metal trays (burn pans) with locking covers. Most of the residual ash was disposed of at the Gate 19 Landfill until its closure in October 1993. Currently the ash is disposed of off site. The primary wastes potentially resulting from open burning of propellants include trinitrotoluene, dinitrotoluene, and heavy metals. The area around the burn pans has little or no vegetation (Ref. 10, Vol. I, p. 11-1).

Herbicides have been used in the source area to remove and control vegetation, and this may have resulted in soil contamination. During the period when open burning was conducted on the ground surface, some type of petroleum hydrocarbon may have been used as a fire starter, possibly resulting in soil contamination with explosives and heavy metals (Ref. 10, Vol. I, p. 11-1).

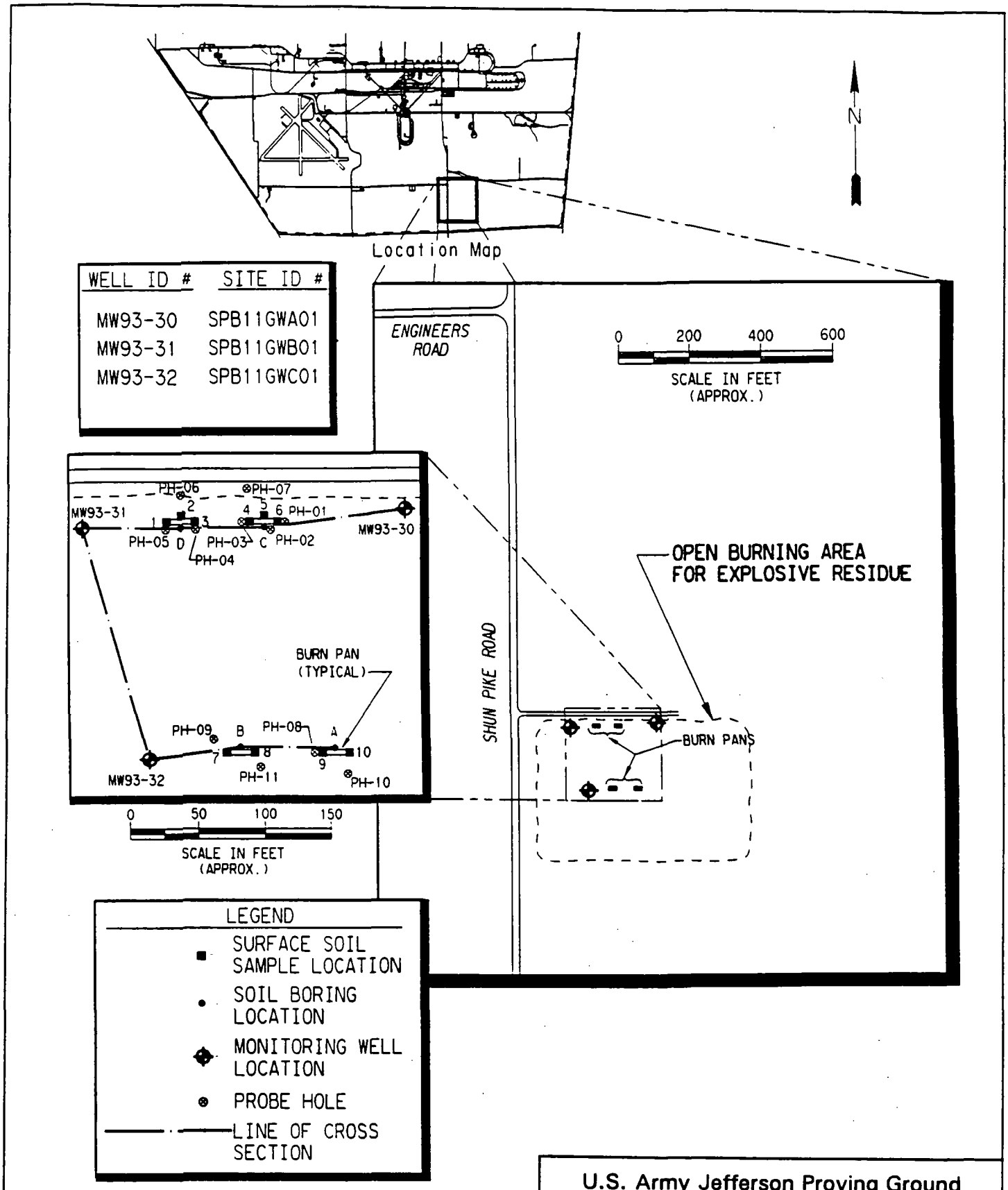
The depth to groundwater in the source area was found to range from 4 to 19 feet bgs during the 1993 RI (Ref. 10, Vol. I, p. 11-2).

Dates of Operation and Releases:

The source area has been used since the early 1950s to burn excess propellant (Ref. 10, Vol. I, p. 11-1). An area of discolored gravel observed during a 1990 environmental audit was recorded as evidence of a past release of hazardous substances (Ref. 18, pp. 61 and 62).

Sampling Activities:

Both total metal and toxicity characteristic leaching procedure (TCLP) metal analyses of surface soil samples collected from the source area during the 1993 RI revealed elevated concentrations of lead. Two herbicide breakdown compounds (2,4,5-TP and 2,4-D) were also detected in the surface soil samples. VOCs were not detected in these samples, but one SVOC, di-n-butylphthalate, was detected (Ref. 10, Vol. I, p. 11-4, Table 11-1, and Fig. 11-1).



Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

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Madison, IN

Figure 6
Burning Area for Explosive Residue (Source 3)

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Subsurface soil samples collected from the source area during the 1993 RI contained elevated concentrations of several metals, including barium, copper, manganese, and mercury (Ref. 10, Vol. I, p. 11-4, Table 11-1, and Fig. 11-1).

In other investigations conducted before the 1993 RI, 2,4-dinitrotoluene, 2,6-dinitrotoluene, HMX, and trinitrotoluene were detected in surface and subsurface soil samples collected from this source area (Ref. 18, p. 62).

Analysis of groundwater samples collected from MWs in the source area during the 1993 RI revealed elevated concentrations of arsenic and barium. No SVOCs, VOCs, explosives, or herbicides were detected in the samples (Ref. 10, Vol. I., p. 11-5, Table 11-1, and Fig. 11-1).

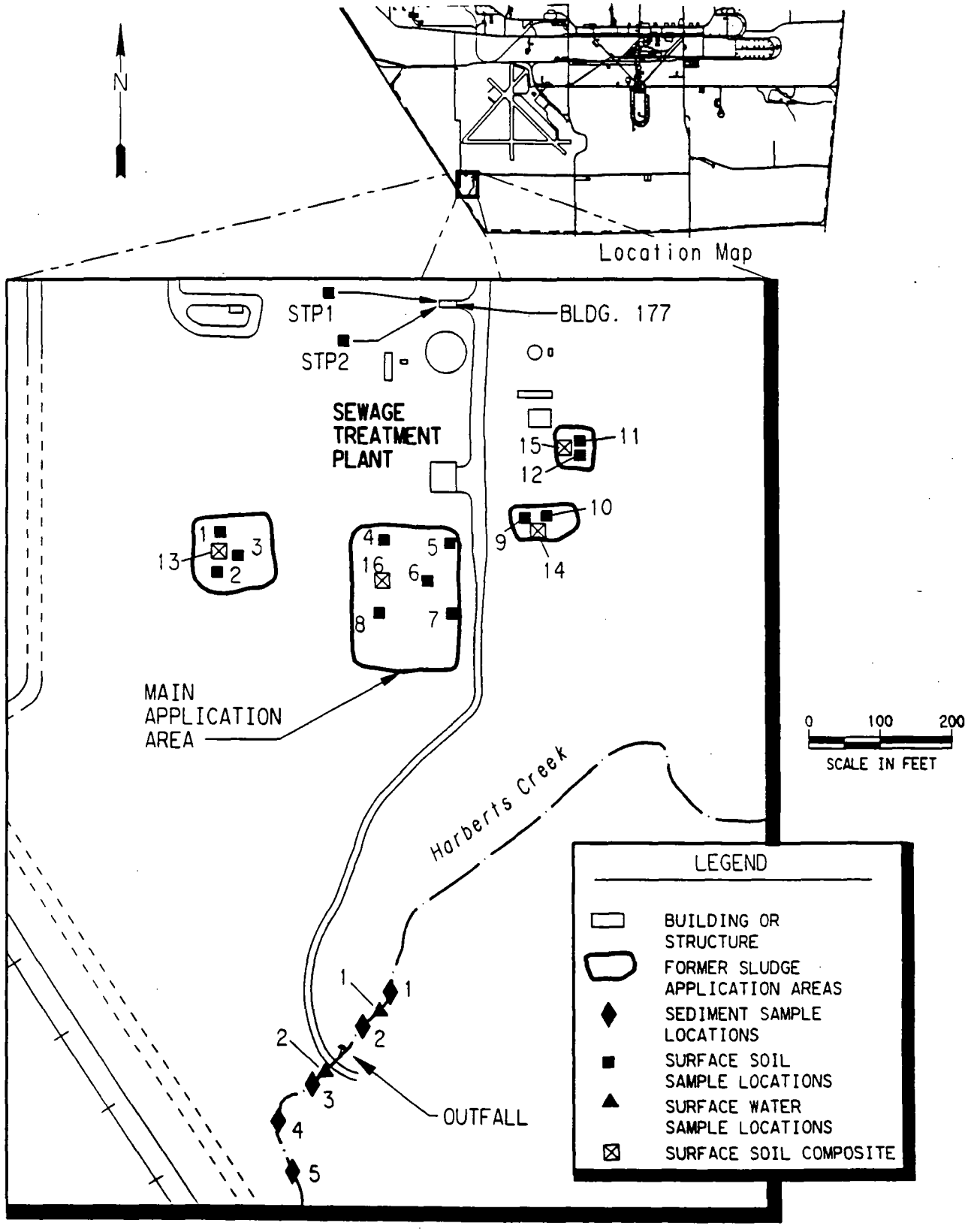
4.4 SEWAGE TREATMENT PLANT

Source Description:

The Sewage Treatment Plant (STP) (Source 4) is located in the southwestern corner of JPG near the intersection of Engineers Road and Tokyo Road. Figure 7 shows Source 4 sampling locations. In this source area, the flat to gently rolling land surface slopes to the southeast toward Harberts Creek, which is about 800 feet away. The area immediately surrounding the STP is grass-covered and is regularly mowed (Ref. 10, Vol. I, p. 5-1; Ref. 19).

The STP can process about 280,000 gallons per day (gpd) of domestic and industrial wastewater. The treatment facility consists of a settling tank (Imhoff tank), sludge-drying beds, and a trickling filter system, in which the processed water is recirculated several times before its discharge through an NPDES-permitted outfall to Harberts Creek.

Most of the wastewater treated in the STP is domestic sewage, but rinses from Building 208 (the photographic laboratory), boiler blowdown water, and water from the Building 186 oil-water separator are also treated at the plant. The rinses from the photographic laboratory consist of photographic waste (about 170 gpd). Until 1980, the photographic waste contained bleaches, cyanide, and silver. In 1980, the photographic development process was changed to eliminate the use of bleaches and cyanide (Ref. 4, p. 3-7; Ref. 10, Vol. I, p. 5-1). The silver has been recovered from the photographic waste since 1967 (Ref. 16, p. 17). In 1993, a distillation unit was installed at the STP to treat the photographic waste before its discharge in order to improve silver recovery (Ref. 15, Executive Summary). In addition, 200 to 300 gpd of boiler blowdown water is treated at the STP and discharged to the sanitary sewer system (Ref. 3, p. 25). The water entering the boiler is softened by the addition of sodium hydroxide, tannin, and cyclohexylamine for steam operations (Ref. 9a;



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Madison, IN

Source: Reproduced from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc., Volume I. July.

Figure 7
Sewage Treatment Plant (Source 4) and Sewage Sludge Application Areas (Source 5)

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Ref. 10, Vol. I, p. 5-1). The amount of industrial wastewater from the Building 186 oil-water separator that is treated at the STP could not be determined (Ref. 10, Vol. I, p. 5-1).

In March 1975, an NPDES inspection of the STP revealed that the flow to the plant during wet weather was up to four times greater than the base flow. The additional water entering the STP during wet weather was identified as storm water infiltrating into the vitreous clay pipes of the sanitary sewer lines leading to the plant. By summer 1989, replacement of 28,000 feet of sewer pipe had mitigated the infiltration problem (Ref. 10, Vol. I, p. 5-1).

Although the outfall to Harberts Creek is monitored to comply with NPDES permit requirements, bypass releases of untreated wastewater to the creek have occurred almost 100 times from June 1988 to June 1989. These untreated wastewater releases may have contaminated the surface water and sediments (Ref. 18, p. 11).

Dates of Operation and Releases:

The STP began operation in 1942 and is currently active. As early as the 1970s, contamination of surface water by STP operations was suspected. On May 13, 1974, correspondence from the Indiana State Board of Health (ISBH) to JPG documented state concerns regarding annual fish kills in Harberts Creek downstream of the plant for the previous 10 years. ISBH suspected that activities associated with the STP were the cause of the fish kills because of their chronic nature and the location of the plant (Ref. 16, Appendix I, p. I-3). Untreated wastewater from numerous industrial activities has bypassed the STP and entered Harberts Creek. The amount of untreated wastewater discharged into the creek is unknown.

Sampling Activities:

Except for routine sampling of the NPDES outfall and sampling of sewage sludge to determine its off-site disposition, no environmental samples were collected at the STP before 1993. During the 1993 RI, two surface soil samples were collected from the source area and analyzed for metals, SVOCs, and total petroleum hydrocarbons (TPH) (Ref. 10, Vol. I, pp. 5-2 and 5-3). Elevated concentrations of chromium, silver, and zinc were detected in these samples (Ref. 10, Vol. I, p. 5-4, Table 5-1, and Fig. 5-1).

During the 1993 third round of stream sampling at JPG, samples were collected from the STP discharge stream to identify the source of silver contamination of Harberts Creek. Three STP effluent samples were analyzed for mercury as well as silver contamination, and the results revealed both mercury and silver contamination (Ref. 15, pp. 11 and 12, and Table E-10).

4.5 SEWAGE SLUDGE APPLICATION AREAS

Source Description:

The four Sewage Sludge Application Areas (SSAA) (Source 5) cover an area of 46,500 square feet and are located near the STP (Source 4). STP sludge is currently disposed of off site (Ref. 3, p. 25). Historically, however, STP sludge was reportedly disposed of on a "clay bank" south of the Building 185 incinerator. Also, STP sludge reportedly was spread on fields at JPG. During the 1993 RI, JPG personnel were unable to locate any sludge disposal areas other than the four SSAAs in the immediate vicinity of the STP. Also, STP sludge reportedly was stockpiled just east of the sludge-drying beds until its disposal (Ref. 10, Vol. I, p. 5-2). Figure 7 shows Source 5 sampling locations.

The SSAAs are not regularly mowed, but they are sometimes included in the spring open area burning program. They are generally covered by grass and other perennial plants. The two larger SSAAs are bounded on one side by dense woods. During the 1993 RI, no sign of mounding was observed in these areas and the vegetation was well established, indicating that these areas have not been recently used for disposal of sewage sludge (Ref. 10, Vol. I, p. 5-1)

Dates of Operation and Releases:

Sewage sludge disposal on the ground surface in the SSAAs probably began in 1942 at about the same time as the STP began its operations.

Sampling Activities:

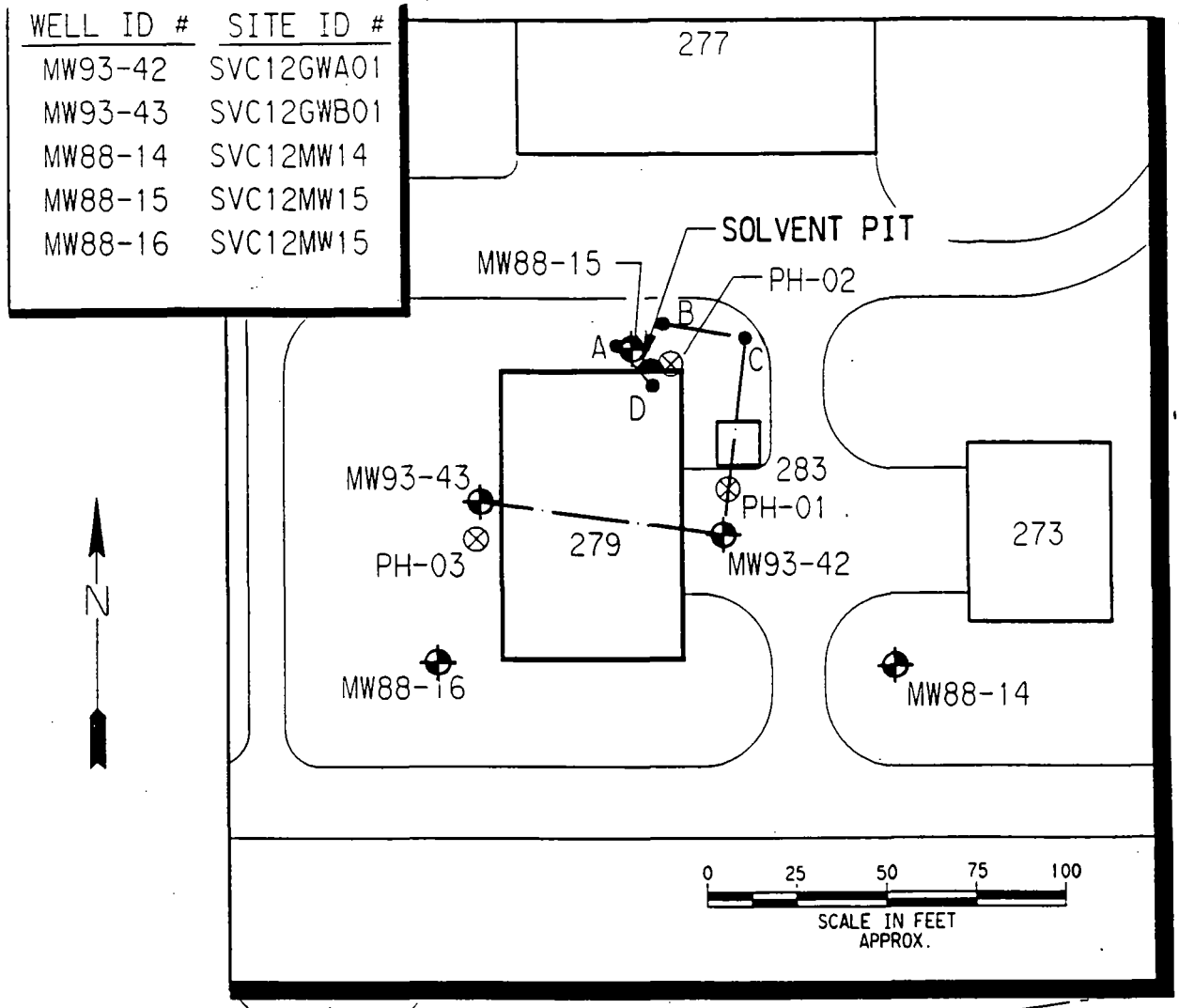
Surface soil samples collected in the four SSAAs during the 1993 RI were analyzed for metals, cyanide, pesticides, and PCBs. Analysis of the samples revealed elevated concentrations of barium, cobalt, copper, lead, mercury, and silver as well as the presence of cyanide and pesticides (Ref. 10, Vol. I, pp. 5-3 and 5-4, Table 5-1, and Fig. 5-1).

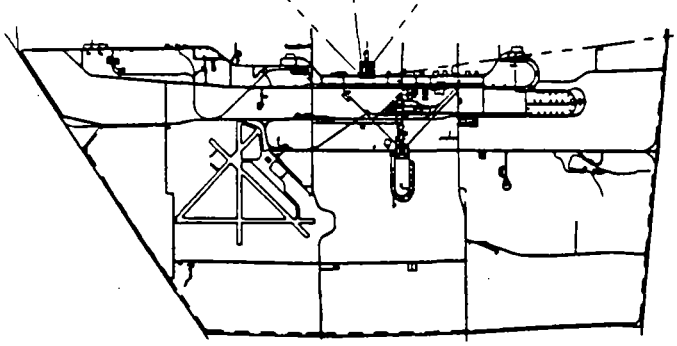
4.6 SOLVENT DISPOSAL PITS ASSOCIATED WITH BUILDINGS 279, 602, AND 617

Source Description:

The three Solvent Disposal Pits (Source 6) are aggregated as one source because (1) they are the same types of sources, (2) similar maintenance activities are associated with them, (3) they display similar waste characteristics, and (4) they are in close proximity. Figures 8a, 8b, and 8c show sampling locations for the Solvent Disposal Pits associated with Buildings 279, 602, and 617, respectively. These three buildings are located near the Firing Line: Building 279 is located one block north of Woodhill Road and two blocks west of Meridian Road along the Firing Line; Building 602 is located just north of Woodfill Road about ⅛ mile west of Tokyo Road; and Building 617 is located between Buildings 279 and 602 along the Firing Line. All three buildings are former ammunition assembly

WELL ID #	SITE ID #
MW93-42	SVC12GWA01
MW93-43	SVC12GWB01
MW88-14	SVC12MW14
MW88-15	SVC12MW15
MW88-16	SVC12MW15





Location Map

LEGEND

- SOIL BORING LOCATION
- MONITORING WELL LOCATION
- BUILDING OR STRUCTURE
- PROBE HOLE
- LINE OF CROSS SECTION

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Figure 8a
Solvent Disposal Pits Associated with Buildings 279, 602, and 617 (Source 6): Building 279

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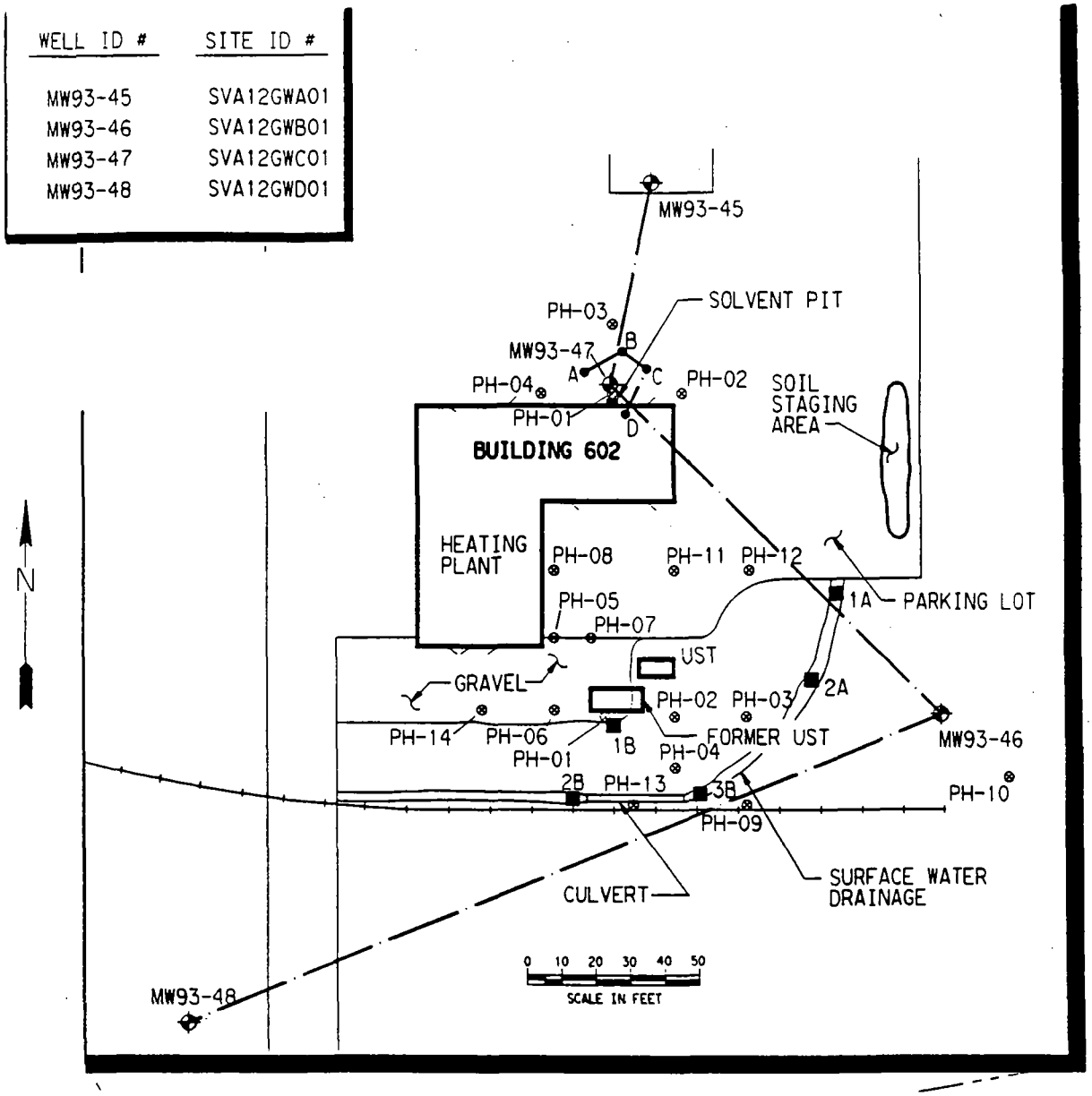
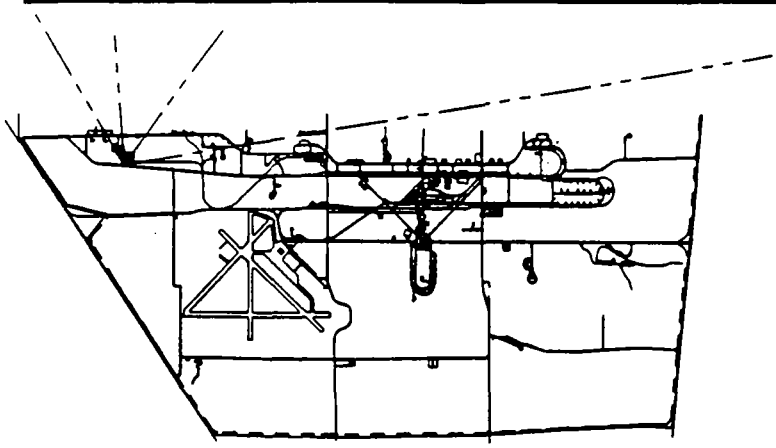
Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc., Volume I. July.

WELL ID #	SITE ID #
MW93-45	SVA12GWA01
MW93-46	SVA12GWB01
MW93-47	SVA12GWC01
MW93-48	SVA12GWD01





Location Map

Legend

- BUILDING OR STRUCTURE
- RAILROAD TRACKS
- DRAINAGE DITCH
- SURFACE SOIL SAMPLE
- MONITOR WELL
- SOIL BORING LOCATION
- PROBE HOLE
- LINE OF CROSS SECTION

Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

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Figure 8b
Solvent Disposal Pits Associated with Buildings 279, 602, and 617 (Source 6): Building 602

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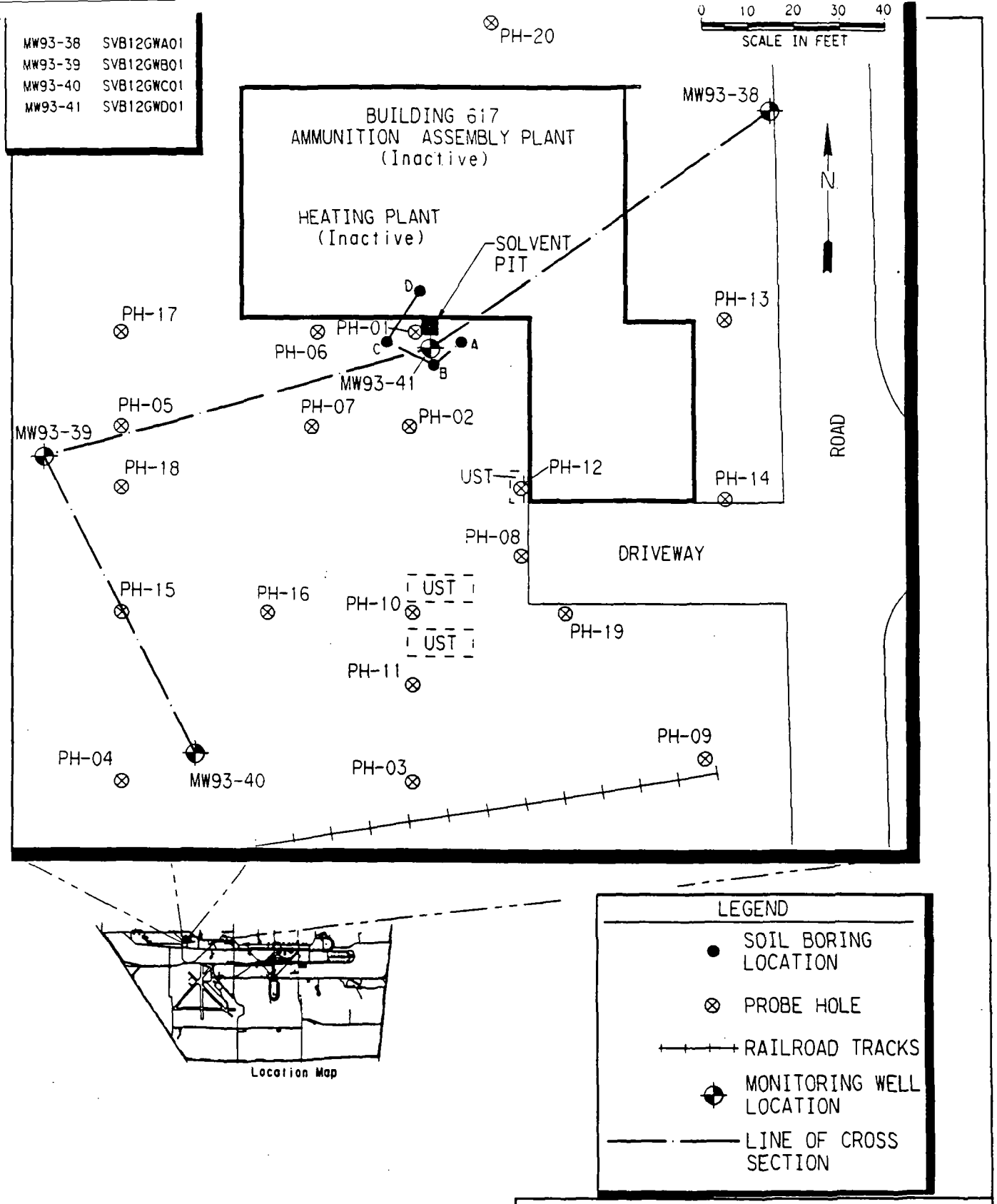

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Figure 8c
Solvent Disposal Pits Associated with Buildings 279, 602, and 617 (Source 6): Building 617

PRC ENVIRONMENTAL MANAGEMENT, INC.

Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

plants (Ref. 10, Vol. I, pp. 12-1, 13-1 and 14-1, Fig. 2-1). A pit was excavated next to each of the three buildings for disposal of waste solvents and degreasers, including TCE. Each of the pits reportedly received a maximum of 500 gallons of waste TCE. Each pit is about 3 feet in diameter and 3 feet deep and is filled with gravel (Ref. 10, Vol. I, pp. 12-2, 13-1, and 14-2).

Surface runoff from these pits eventually discharges to Middle Fork Creek: the surface runoff from the Building 279 pit drains through a network of shallow roadside ditches to the northwest and eventually to Middle Fork Creek; the surface runoff from the Building 602 pit drains into a ditch along the railroad tracks south of the building, flows west toward the Gate 19 pond, and eventually flows to Middle Fork Creek; the surface runoff from the Building 617 pit flows generally to the east and enters a tributary of Middle Fork Creek about 1,500 feet away (Ref. 10, Vol. I, pp. 12-1, 13-1, and 14-1).

Dates of Operation and Releases:

All three pits were used from 1970 to 1978 for disposal of waste solvents and degreasers. The disposal practices used resulted in VOC contamination of the surrounding soils (Ref. 10, Vol. I, pp. 12-2, 13-1, and 14-2).

Sampling Activities:

A soil gas survey and soil sampling were conducted for each pit during the initial 1988 RI. Also, three MWs were installed in the Building 279 pit area at that time. The samples collected near the pits were contaminated with solvent-related VOCs (Ref. 10, Vol. I, pp. 12-3, 13-2, and 14-2):

Soils near the Building 279 pit were found to contain 1,1,1-TCA, hexane, trichlorofluoromethane, 1,1-DCE and TCE, 1,1,2-TCA, 1,1-dichloroethane (1,1-DCA), and toluene (Ref. 5, pp. 5-3 and 5-4; Ref. 10, Vol. I, pp. 14-2 and 14-3).

Soils near the Building 602 pit were found to contain acetone, 1,1,1-TCA, 1,1,2-TCA, 1,1-DCA, 1,2-DCE, TCE, and toluene (Ref. 10, Vol. I, p. 12-3).

Soils near the Building 617 pit were found to contain acetone, benzene, chloroform, 1,1-DCA, 1,2-DCA, 1,1-DCE, 1,2-DCE, 1,1,1-TCA, TCE, and toluene (Ref. 10, Vol. I, p. 13-2).

During the 1993 RI, subsurface soil samples were collected in the pit areas and analyzed for VOCs. In addition, groundwater samples were collected from the MWs and analyzed for VOCs to verify the contamination identified previously. The analytical results are summarized below.

Subsurface soils near the Building 279 pit contained no VOCs. However, 1,1,1-TCA, 1,1-DCE, and TCE were detected in the groundwater (Ref. 10, Vol. I, Table 14-1, and Fig. 14-1)

Subsurface soils near the Building 602 pit contained 1,1,1-TCA. In addition, 1,1,1-TCA and 1,1-DCE were detected in the groundwater (Ref. 10, Vol. I, Table 12-1, and Figs. 12-1 and 12-6).

Both subsurface soils and groundwater near the Building 617 pit contained 1,1,1-TCA, 1,1-DCA, 1,1-DCE, and toluene (Ref. 10, Vol. I, Table 13-1, and Fig. 13-1).

4.7 GATOR Z MINE TEST AREA

Source Description:

The Gator Z Mine Test Area (Source 7) is located in the southeastern corner of JPG, and a tributary of Harberts Creek borders the area on the south. The area is flat with a slight slope to the southwest. Surface runoff drains through ditches along the roadways to the south and flows into the tributary of Harberts Creek (Ref. 10, Vol. I, p. 27-1). Figure 9 shows Source 7 sampling locations.

The source area measures about 220,000 square yards and contains 26 pits in two east-west rows parallel to Mine Field Road. The pits are used to test the performance of explosive mines. Each pit is equipped with a steel box that is open to the soil on the bottom and that has a fitted, removable top. Concrete walls surround the steel box. At the bottom, the box is drained by pipes leading to drainage swales that discharge to Harberts Creek. The two pits at the eastern end of the source area are the most frequently used (Ref. 10, Vol. I, p. 27-1).

Dates of Operation and Releases:

The source area has been active since at least 1985 (Ref. 1, p. 45; Ref. 10, Vol. I, p. 27-2).

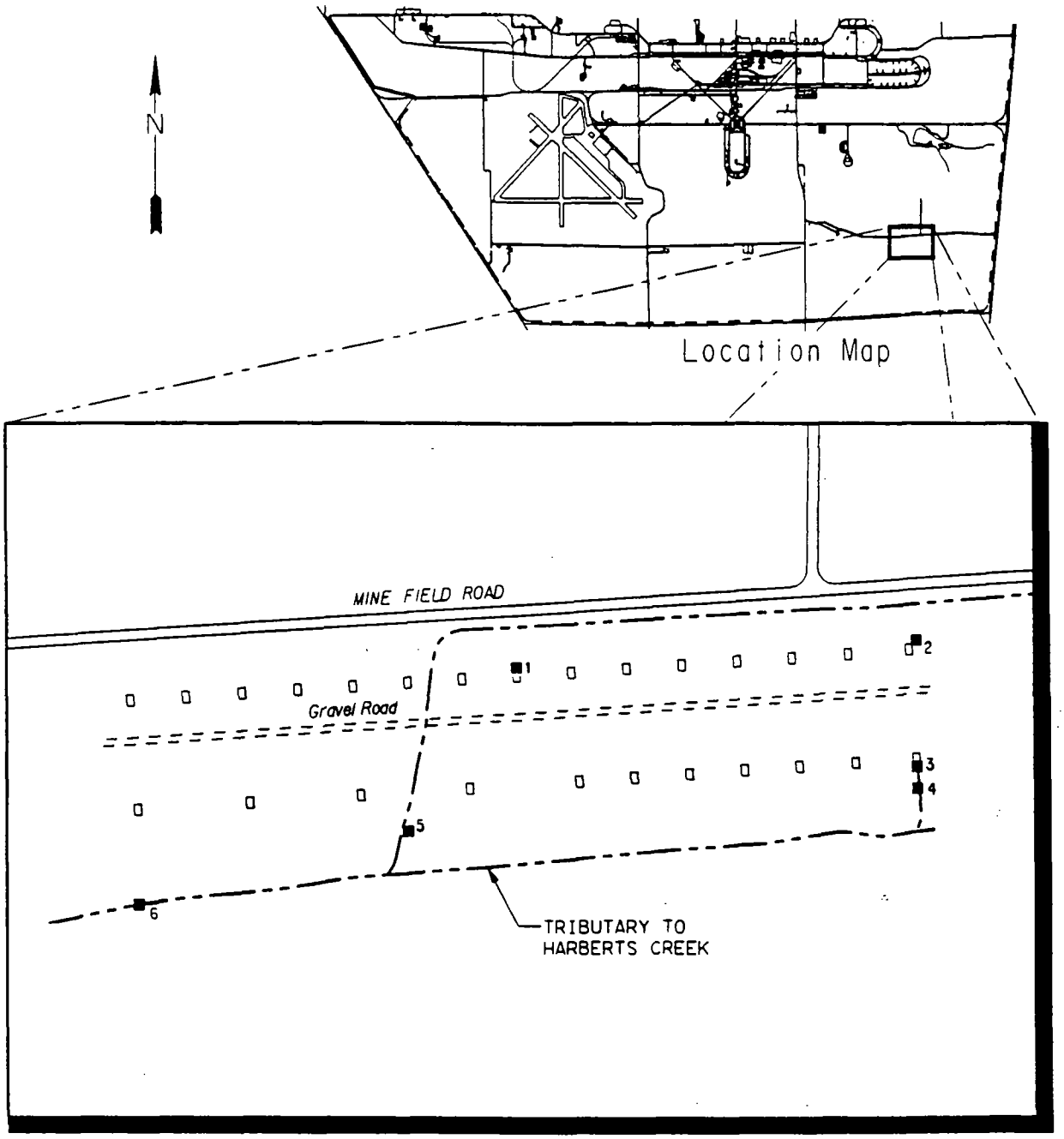
Sampling Activities:

Surface soil samples collected from the source area during the 1993 RI were analyzed for heavy metals and explosive chemicals. These samples contained elevated concentrations of barium, chromium, copper, lead, mercury, nickel, and silver, but no explosive chemicals were detected (Ref. 10, Vol. I, p. 27-4, Table 27-1, and Fig. 27-1).

4.8 BUILDING 305 TEMPORARY WASTE STORAGE AREA

Source Description:

The Building 305 Temporary Waste Storage Area (Source 8) is a one-story, wood-framed structure that is used to store hazardous wastes in containers until their final disposal. The building has also been used as a shop area for the JPG airfield. Figure 10 shows Source 8



Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

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Figure 9
Gator Z Mine Test Area (Source 7)

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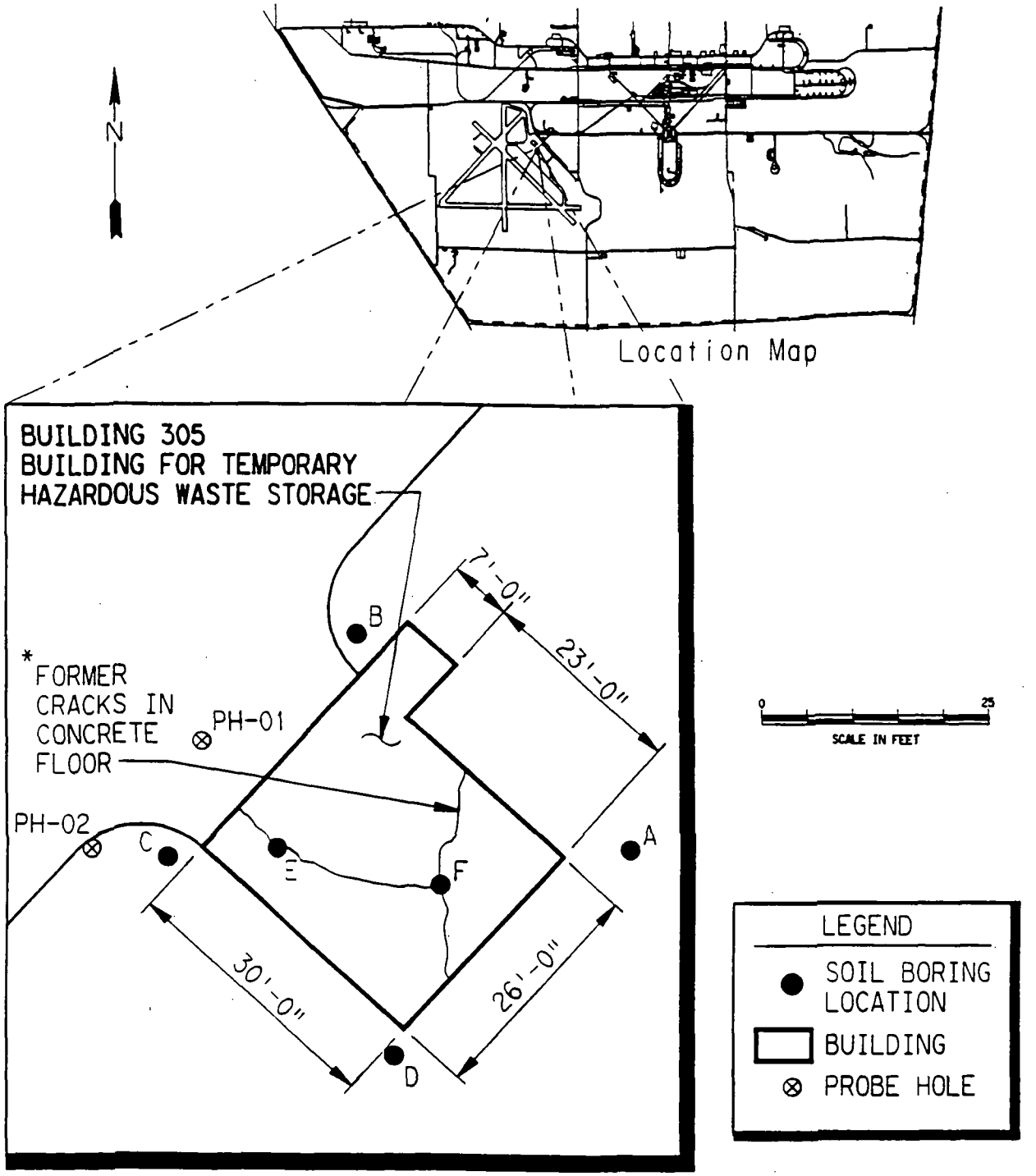

* CRACKS HAVE SINCE BEEN REPAIRED AND VERIFIED SATISFACTORY BY THE IDEM RCRA INSPECTOR.

Source: Modified from U.S. Army Environmental Center. 1994. "Final Draft Remedial Investigation." Prepared by Rust Environmental and Infrastructure, Inc. Volume I. July.

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Figure 10
Building 305 Temporary Waste Storage Area (Source 8)

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sampling locations. Building 305 is located about 200 feet east of the aircraft hangar at the airfield; measures about 25 by 30 feet; and is built on a 6-inch-thick, concrete slab. The slab does not have a spill containment berm. Boards measuring 2 by 6 inches are secured to the building walls and sealed to the concrete floor to provide spill control. Also, metal trays are used to provide secondary spill containment. The concrete floor of the building was observed to have two profound cracks, which have since been repaired. The area around the building is flat. There is concrete and pavement on the western side of the building, and grass covers the ground on the other sides. Surface water runoff from the area is directed into the storm sewer system, which discharges into Harberts Creek to the south (Ref. 10, Vol. I, p. 22-1).

Various wastes generated in facility support buildings are routinely collected in containers, primarily 55-gallon drums. These containers are temporarily stored on wooden pallets inside the building until on-site or off-site disposal of the wastes. Wastes that are or have been stored in the building include stoddard solvent, PCB-contaminated oil, electrical transformers, paint thinners and sludge, spent TCE, asbestos, copper slats, propellant, and bagged ash (Ref. 3, p. 29; Ref. 10, Vol. I, p. 22-1).

Dates of Operation and Releases:

The Building 305 Temporary Waste Storage Area has been used since 1980 (Ref. 3, p. 28).

Sampling Activities:

Analysis of surface soil samples (shallow borehole samples) collected from the source area during the 1993 RI revealed elevated concentrations of arsenic, mercury, silver, and zinc as well as the presence of a PCB (Aroclor 1260). In addition, SVOCs such as benzo(a)anthracene, benzo(k)fluoranthrane, chrysene, flouranthene, fluorene, and pyrene were detected in the samples (Ref. 10, Vol. I, p. 22-3, Table 22-1, and Fig. 22-1).

Analysis of subsurface soil samples collected from the source area during the 1993 RI revealed elevated concentrations of heavy metals, including barium and lead, and the presence of SVOCs, including fluoranthene, fluorene, and phenanthrene (Ref. 10, Vol. I, Table 22-1, and Fig. 22-1).

5.0 MIGRATION AND EXPOSURE PATHWAYS

This section describes the four migration and exposure pathways associated with the JPG site. Section 5.1 discusses the groundwater migration pathway; Section 5.2 discusses the surface water migration pathway; Section 5.3 discusses the soil exposure pathway; and Section 5.4 discusses the air migration pathway.

5.1 GROUNDWATER MIGRATION PATHWAY

Groundwater use in the JPG site area is limited. Although the groundwater pathway is not being evaluated, this section has been included because: (1) analytical data from numerous monitoring wells are available to help characterize sources evaluated at JPG, and (2) groundwater discharges to surface water at various location within the facility.

This section discusses geology and soils, groundwater releases, and targets associated with the groundwater migration pathway at the JPG site.

5.1.1 Geology and Soils

JPG is located along the southern fringe of the Central Lowlands province in the Till Plains section, which is characterized by young till plains with no pronounced morainic features (Ref. 10, Vol. I, p. 2-1). The site and immediate area are underlain by unconsolidated glacial materials over carbonate bedrock (limestone and dolomite) (Ref. 7, p. 6; Ref. 10, Vol. I, p. 2-11). JPG lies on the western flank of a broad structural feature called the Cincinnati Arch. Uplift of this arch has caused the bedrock to dip to the west-southwest at 20 to 25 feet per mile (Ref. 10, p. 2-11).

Two hydrostratigraphic units underlie JPG: (1) the unconsolidated glacial deposits and (2) the deeper Devonian and Silurian limestones and dolomites (Ref. 10, Vol. I, pp. 2-11 and 2-14). All lithologic units beneath JPG are believed to be hydraulically interconnected and to function as a water table aquifer with localized, semiconfined zones (Ref. 1, p. 58). The depth to groundwater at JPG is generally less than 20 feet (Ref. 6, p. E-4). Groundwater was encountered as shallow as 5 feet bgs during installation of MWs in 1993 (Ref. 10, Vol. I, p. 2-13). This groundwater is probably at the soil-bedrock interface, which can be a zone of groundwater occurrence; where present, this zone would likely be considered the uppermost aquifer at JPG (Ref. 6, p. E-4). The regional direction of groundwater movement in the glacial till is to the west-southwest, a direction that coincides with the direction of surface drainage and the regional dip of the bedrock (Ref. 6, p. E-4). Locally, however, the groundwater in the till appears to move toward the nearest surface water drainage (Ref. 10, Vol. I, p. 2-12).

Groundwater at JPG is found primarily in the Devonian and Silurian limestones and dolomites. Groundwater yields from this consolidated bedrock aquifer are poor to moderate; often the maximum

yields are 25 to 50 gpd (Ref. 5, p. 1-6). The Louisville Limestone and the Laurel Member of the Salamonie Dolomite are the principal shallow bedrock water-bearing units south of the Firing Line.

Based on analysis of water level elevation data for JPG, the direction of bedrock groundwater flow is to the west-southwest (Ref. 10, Vol. I, p. 2-13). Fracturing and fault planes within the bedrock units may change the flow direction locally (Ref. 5, p. 1-6). Minor karst surface features have been observed in several source areas at JPG, and the voids, lost circulation zones, and solutioned-out fractures observed in rock cores during bedrock drilling are further evidence of the presence of karst geologic terrain (Ref. 10, Vol. I, p. 2-14).

JPG surface soils originated from glacial till and outwash, lacustrine deposits, limestone and shale residuum, alluvium, and loess (windblown silt). The soils are strongly weathered, leached, and acidic (Ref. 7, p. 7). The soils are complex and variable throughout the site (Ref. 7, p. 8). The soils can be characterized as three major types: Avonburg Silt Loam, Cobbsfork Silt Loam, and Rossmoyne Silt Loam. The Avonburg and Cobbsfork Silt Loams are gently sloping, poorly drained soils formed in a thin mantle of loess and glacial drift. Both soils are characterized as strongly acidic to very strongly acidic and as very slowly permeable but not subject to flooding (Ref. 5, pp. 1-5 and 1-6). The Rossmoyne Silt Loam is a deep, nearly level to very steep, moderately well drained soil. It is formed in a thick mantle of loess and glacial drift. Available water capacity is moderate, and the soil is not subject to flooding (Ref. 5, p. 1-6).

5.1.2 Groundwater Releases

Numerous MWs were installed at JPG during 1981, 1988, and 1993 field investigations. Groundwater sample analytical results are available for four of the eight sources being evaluated. At these four sources, groundwater contamination has been documented. Hazardous substances found in the groundwater include heavy metals, VOCs, and SVOCs. Because groundwater is not used as drinking water within a 4-mile radius of the cantonment area of JPG, hazardous substances detected in groundwater are used only to characterize the sources evaluated. Therefore, the groundwater sample analytical results are not summarized in this section. Refer to Section 4.0 for a summary of the sampling activities associated with the sources evaluated at JPG.

5.1.3 Targets

The groundwater under JPG is generally of poor quality. It is not used as drinking water or for other purposes to any significant extent. Drinking water at JPG is obtained from the City of Madison, whose drinking water is supplied from alluvial deposits in the Ohio River Valley about 5 miles south of JPG (Ref. 10, Vol. I, p. 2-10). The 1993 Preliminary Site Investigation Report identified the nearest well to JPG as being a private well located about ½ mile southwest of the Gate 19 Landfill. The well is associated with a farmhouse and is likely used for irrigation purposes (Ref. 8).

5.2 SURFACE WATER MIGRATION PATHWAY

This section discusses the migration route, surface water releases, and targets associated with the surface water migration pathway at the JPG site.

5.2.1 Migration Route

Many scattered, small ponds and several lakes are present at JPG. Six major, parallel creeks flowing generally to the west-southwest, dissect JPG, as shown in Figure 2. These creeks are associated with the White River Basin (Ref. 1, p. 53). According to the 1980 installation assessment, these creeks serve as major drainageways, have cut into the underlying limestone, and have formed vertical banks 20 to 23 meters (about 0.01 mile) high. Each creek has a well developed drainage net consisting of numerous tributaries. Surface drainage north of the Firing Line has not been significantly altered by artificial structures. Surface drainage within the cantonment area of JPG is controlled by storm sewers that discharge into open ditches emptying into Harberts Creek. Harberts Creek originates within the boundaries of JPG, flows about 2.2 miles across the site, and leaves JPG along its southwestern boundary (Ref. 16, p. 7; Ref. 20).

Six sources being evaluated for JPG are located within the Harberts Creek drainage basin; the other two sources being evaluated lie within the drainage basin of Middle Fork Creek. Both of these creeks flow into Big Creek within the 15-mile surface water target distance limit (TDL) (Ref. 20).

The STP (Source 4) is located about 800 feet north of Harberts Creek. The STP is the source furthest downstream in the Harberts Creek drainage basin. The STP discharges treated wastewater through an NPDES-permitted outfall into Harberts Creek about 500 feet upstream of the point where

the creek exits the site (Ref. 15, p. 5). The Gator Z Mine Test Area (Source 7) is the source furthest upstream in the Harberts Creek drainage basin. Surface runoff from Source 7 travels overland about 400 feet until it discharges to an intermittent branch of Harberts Creek. This intermittent branch joins the perennial flow of Harberts Creek about 1.4 miles downgradient. The other sources being evaluated that drain to Harberts Creek are Sources 2, 3, 5, and 8. The 15-mile TDL for Harberts Creek is measured from 1993 RI sampling location EX-1, which is about 500 feet downstream from the STP effluent discharge point in the creek (Ref. 15, p. 5); the TDL ends in Big Creek (Ref. 20). The flow rate of Harberts Creek is 13 cubic feet per second (cfs) (Ref. 1, p. 53).

Of the two sources being evaluated that are located in the drainage basin of Middle Fork Creek, the Gate 19 Landfill (Source 1) is the source further downstream (Ref. 20). Most surface runoff from the Gate 19 Landfill flows southwest toward the Gate 19 pond (which is evaluated as part of the Gate 19 Landfill source area). From the pond, drainage flows west via a small channel through open farmland for about ¼ mile to an intermittent tributary of Middle Fork Creek. After about 0.9 mile, the tributary joins the perennial reach of Middle Fork Creek (Ref. 10, Vol. I, p. 10-1; Ref. 20). The Solvent Disposal Pits Associated with Buildings 279, 602, and 617 (Source 6) is the source further upstream in the Middle Fork Creek drainage area. Surface runoff from the Building 279 pit area drains to the northwest through a network of shallow roadside ditches for about 700 feet to another intermittent tributary of Middle Fork Creek. The tributary enters the perennial portion of Middle Fork Creek after about 1.4 miles (Ref. 17; Ref. 20).

5.2.2 Surface Water Releases

As early as the 1970s, contamination of surface water by JPG operations was suspected. In 1974, the State of Indiana Division of Water Pollution Control sent a letter to JPG regarding annual fish kills in Harberts Creek downstream of the STP outfall over the previous 10 years; the letter recommended monitoring of STP operations because it was suspected to be a potential source of contamination (Ref. 16, Appendix I, p. I-3). The first sampling of surface water at JPG occurred in 1992; additional sampling was conducted in July 1992 and in June and July 1993. The results are summarized below.

From November 1991 through January 1992, the U.S. Army Toxic and Hazardous Materials Agency implemented a site-specific sampling and analysis program at JPG. This program involved collection of samples from both the entrance and exit points of streams crossing JPG. Entrance point samples

were analyzed for six herbicides, arsenic, and total uranium; exit point samples were analyzed for herbicides, explosive compounds, target compound list metals, total uranium, and cyanide (Ref. 11, p. 24). According to results documented in May and August 1992 letter reports, analysis of the exit point samples revealed arsenic, mercury, and silver in surface water and sediment; however, the mercury results were considered to be questionable because mercury contamination was found in two quality control samples (Ref. 14, p. 2).

In July 1992, the U.S. Army Environmental Hygiene Agency (USAEHA) conducted sampling efforts at JPG to verify the previous surface water and sediment analytical results. Surface water and sediment samples were collected from 20 locations, including the entrance points, midpoints, and exit points of Harberts, Middle Fork, Graham, and Otter Creeks. These samples were analyzed for mercury, arsenic, and silver (Ref. 14, p. 3). Except for field duplicate samples, no quality control samples were collected (Ref. 14, Appendix C). Mercury was not detected in any of the samples (Ref. 14, pp. 5 and 8). Arsenic, although it was detected in all samples, appeared to be present at background levels (Ref. 8, pp. 8 and 9). Silver was detected in two surface water samples collected from Harberts Creek. The higher silver concentration was found at location EX-1, near the point where Harberts Creek exits JPG (Ref. 14, p. 6). USAEHA concluded that elevated concentrations of silver existed in Harberts Creek water (Ref. 14, p. 9).

In July 1993, USAEHA conducted another round of stream sampling at JPG, and sample analysis again revealed mercury and silver at elevated concentrations. In addition to resampling selected stream entrance and exit points, this study represented the first extensive sampling of the Harberts Creek drainage basin (Ref. 15, pp. 5, 8, and 9). Samples collected at location EX-1, samples of storm drain discharges to Harberts Creek, and samples of effluent from the STP were analyzed for mercury and silver; other samples collected within the creek basin were analyzed for silver only (Ref. 15, pp. 9 and 11). Sample analytical results documented elevated concentrations of both mercury and silver to Harberts Creek. In addition, both of these metals were found in the STP effluent sample (sample SPT-1) collected from the outfall to Harberts Creek, which lies about 500 feet upstream from sampling location EX-1 (Ref. 15, p. 5 and Tables E-10 and E-14).

Concentrations of silver in both surface water and sediment samples collected from location EX-1 are significantly higher than concentrations found in samples collected from location EX1D, which represents a background sampling location in Harberts Creek upstream of the STP discharge point. Concentrations of silver in sediment samples from background location EX-1D were below the

detection limit of 0.1 microgram per gram (μg/g). Concentrations of silver in sediment samples from location EX-1 ranged from 2.4 to 3.3 μg/g. The sediment samples from these two locations were collected during the same time period. In surface water, the concentration of silver at background location EX-1D on July 24 and July 27 ranged from < 0.2 to 0.26 microgram per liter (μg/L). At sampling location EX-1, the concentration of silver on these 2 days ranged from 9.6 to 19.4 μg/L (Ref. 15, Fig. 1 on p. 6, Table E-4 on p. E-5, and Table E-16 on p. E-21). Based on these results, USAEHA concluded that the STP, which receives photographic wastes, was the source of silver contamination in Harberts Creek (Ref. 15, Tables E-7, E-10, E-11, E-12, E-13, and E-14).

Analytical results for sediment samples collected in Harberts Creek upstream and downstream from the STP discharge point as part of the 1993 RI also document an elevated concentration of silver in Harberts Creek. RI sample analytical results also document an elevated concentration of copper in the creek. The concentration of copper at sampling location 3 downstream of the STP outfall was 43.5 μg/g, which was more than three times the copper concentration at either of two background sampling locations (Ref. 10, Vol. I, Table 5-1 on p. 5-12, and Fig. 5-1 on p. 5-15).

The mercury, silver, and copper concentrations found in Harberts Creek are at least partially attributable to operations at the STP (Source 4) and at the SSAAs (Source 5). Both mercury and silver were detected in the STP effluent discharged into the creek, and both metals were detected at elevated concentrations in soil samples collected from the source area (STP-1) during the 1993 RI. In addition, several hazardous waste streams, including photographic waste, are known to be sent to the STP for treatment. Soil samples collected in the SSAAs during the 1993 RI contained elevated concentrations of mercury, silver, and copper, and the SSAAs drain to Harberts Creek. Also, untreated wastewater from numerous industrial activities reportedly bypassed the STP and discharged directly into Harberts Creek almost 100 times from June 1988 to June 1989 (Ref. 10, Vol. I, p. 5-6; Ref. 18, p. 11).

In addition, the Gate 19 pond reportedly was closed to fishing because of organic and inorganic contamination (Ref. 19, pp. 10 and 51). According to a JPG wildlife manager, the pond has been closed at least 13 years because of this contamination (Ref. 9b). Although the analytical results for this documented contamination were not available for review, the analytical results for pond surface water and sediment samples collected during the 1993 RI revealed contamination with 1,3,5-trinitrobenzene and heavy metals (Ref. 10, Vol. I, p. 10-6; Ref. 19, p. 10).

5.2.3 Targets

No drinking water intakes exist within the 15-mile surface water TDL (Ref. 1, p. 53). The primary uses of surface water in the vicinity of JPG are for recreation and livestock watering (Ref. 10, Vol. I, p. 2-9). Recreational fisheries are present in Middle Fork Creek and Harberts Creek (Ref. 1, p. 60 and Fig. 2-16).

Five federally listed endangered species and 22 state listed endangered species are known to be present in the site area; two federally listed endangered species reportedly use Harberts Creek and Middle Fork Creek (Ref. 6, Section K). According to a 1993 report, habitat for the Indiana bat, a federally listed endangered species, is present along the banks of Harberts Creek; however, it is not known whether the habitat is on or off site along Harberts Creek (Ref. 2, pp. 11 and 13). A 1994 report indicates that the Indiana bat could also use Middle Fork Creek (Ref. 19, p.42). In addition, the bald eagle, a federally listed endangered species reportedly has been observed near the mouth of Harberts Creek in Krueger Lake and in the northern part of JPG near Old Timber Lake (Ref. 6, Section K).

5.3 SOIL EXPOSURE PATHWAY

Analytical results for surface soil samples collected from all eight sources evaluated for JPG indicate that soils have been contaminated with hazardous substances such as heavy metals, solvent-related VOCs, SVOCs, pesticides, herbicides, and PCBs. However, the targets for these areas of observed contamination are limited to occasional workers, and access to the entire site is controlled by fencing and security guards (Ref. 10, Vol I, pp. 5-1, 5-2, 6-1, 10-1, 11-1, 12-1, 13-1, 14-1, 22-1, 22-2, 27-1, and 27-2). JPG is scheduled for closure, but about 367 people still work on site, and six on-site residences are still used. The on-site residences, which have about 25 occupants, are located along Officer Quarter Road (Ref. 6, Vol. I, p. B-2). The area of surficial contamination nearest these residences is the Gator Z Mine Test Area (Source 7), which is located between ½ and ¾ mile away. Although an endangered species, the bobcat, has been observed at JPG, its presence has not been documented within any on-site area of observed contamination (Ref. 6, Section K). Because of lack of targets, the soil exposure pathway has not been evaluated further.

5.4 AIR MIGRATION PATHWAY

Although JPG has conducted OB/OD activities on site, the air migration pathway has not been evaluated because of insufficient data.

6.0 SUMMARY

Analytical results for groundwater samples collected since 1981 document contaminant releases to the groundwater migration pathway from four of the eight JPG sources evaluated. No municipal wells are located within a 4-mile radius of the site. Available information does not indicate use of private wells for drinking water purposes near any of the sources evaluated.

Analytical results for sediment and surface water samples document releases to the surface water migration pathway. No surface water intakes exist within 15 miles downstream of the site; however, recreational fisheries are present in Middle Fork Creek and Harberts Creek. 1.6 miles of wetland frontage lies along Harberts Creek, 0.96 miles of wetland frontage lies along Middle Fork Creek, and 7.8 miles of wetland frontage lies along Big Creek. The banks of Harberts Creek and Middle Fork Creek could serve as habitats for the Indiana bat and bald eagle, both federally listed endangered species.

Sample analytical results document soil contamination in the eight source areas evaluated. However, targets for these areas of observed contamination are limited to occasional workers, and access to the entire site is controlled by fencing and security guards. JPG is scheduled for closure, but about 367 people still work on site, and six on-site residences are still used. The on-site residences, which have about 25 occupants, are located along Officer Quarter Road. The area of surficial contamination nearest these residences is the Gator Z Mine Test Area (Source 7), which is located between ½ and ¾ mile away. Although an endangered species, the bobcat, has been observed at JPG, its presence has not been documented within any on-site area of observed contamination. Because of lack of targets, the soil exposure pathway has been evaluated further.

Although JPG has conducted OB/OD activities on site, the air migration pathway has not been evaluated because of insufficient data.

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ENCLOSURE 2

U.S. ENVIRONMENTAL PROTECTION AGENCY
RECOMMENDATION FOR
U.S. ARMY JEFFERSON PROVING GROUND
EPA ID NO. IN5 210 020 454

(One Sheet)

U.S. ENVIRONMENTAL PROTECTION AGENCY RECOMMENDATION

Site Name:	U.S. Army Jefferson Proving Ground Madison, Indiana
EPA ID No.:	IN5 210 020 454
Report Author:	Dana Mun PRC Environmental Management, Inc. (703) 287-8873
Contractor Project Manager:	Sandy Anagnostopoulos PRC Environmental Management, Inc. (312) 946-6476

EPA RECOMMENDATION	**SIGNATURE**	**DATE**
"H": High priority for further site assessment	_____	_____
"L": Low priority for further site assessment	_____	_____
"D": Deferred to other authority (RCRA, TSCA, or NRC)	_____	_____
"N": No further action	_____	_____

EPA Comments:

_____

_____

_____

ENCLOSURE 3

TRANSMITTAL MEMORANDUM
WITH PRELIMINARY HRS SCORESHEETS
FOR
U.S. ARMY JEFFERSON PROVING GROUND
MADISON, INDIANA

(21 Sheets)

MEMORANDUM

DATE: November 13, 1995

TO: Jeanne Griffin, Site Assessment Manager
U.S. Environmental Protection Agency (EPA) Region 5

FROM: Dana Mun, PRC Environmental Management, Inc. (PRC)

SUBJECT: Site Evaluation
Site Name: U.S. Army Jefferson Proving Ground (JPG)
Location: Madison, Indiana
EPA ID No.: IN5 210 020 454

THIS DOCUMENT IS CONFIDENTIAL. Because of their predecisional nature, this memorandum and the attached preliminary Hazard Ranking System (HRS) scoresheets are not to be released to the public.

The site evaluation report accompanies this transmittal memorandum and the preliminary HRS scoresheets.

The site has been evaluated to determine the need for immediate removal action as a result of a substantial threat to human health and the environment. PRC recommends the following:

____ The site **does** present a threat that requires immediate removal action.

_X_ The site **does not** present a threat that requires immediate removal action.

PRC has prepared the attached preliminary HRS scoresheets for the above-referenced site.

____ The preliminary HRS score is **below** 28.50.

_X_ The preliminary HRS score is **above** 28.50.

Following is a summary of factors affecting the preliminary HRS pathway scores.

The JPG site is a roughly rectangular parcel of land covering about 55,265 acres. JPG is situated in parts of rural Jefferson, Jennings, and Ripley Counties in southeastern Indiana. The predominant land use within 1 mile of the site is agricultural.

The U.S. Army Testing and Evaluation Command has operated JPG as a proving ground since 1941. JPG's mission has been to plan and conduct production acceptance tests, reconditioning tests, surveillance tests, and other studies of ammunition and weapon systems. Testing and other operations at JPG have involved a variety of waste management practices, including detonation and burning of materials on open ground, percolation of liquid wastes into the ground, landfilling, and incineration. General categories of wastes disposed of at the site have included materials contaminated with propellants, explosives, and solvents; untreated industrial wastewater; and construction rubble.

JPG is divided into two distinct functional areas by the Firing Line, a line of gun positions that runs from east to west across JPG about 2 miles from the site's southern boundary. To the north of the Firing Line are the impact areas, and to the south is the industrial or cantonment area. In addition, six major, parallel creeks, flowing generally to the west-southwest dissect JPG. These creeks have cut into the underlying limestone and have formed vertical banks. Each creek has numerous tributaries. The surface drainage north of the Firing Line has not been significantly altered by artificial structures. Surface drainage in the cantonment area is controlled by storm sewers that discharge into open ditches emptying into Harberts Creek.

Fifty potential waste sources have been identified south of the Firing Line at JPG. Eight of the 50 sources identified were considered in the HRS evaluation of the site. These eight sources have been documented as containing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances, and extensive sample analytical data are available for these sources. The area north of the Firing Line contains significant amounts of unexploded ordnance (UXO); however, this area was not evaluated because insufficient information is available for HRS scoring.

The JPG site has been assigned a preliminary HRS score of 28.8 based on documented observed releases of copper, mercury, and silver from JPG sources to Harberts Creek, a known fishery. Surface water is used as a resource near the site, and the Indiana bat, a federally listed endangered species, may be present in habitats along Middle Fork Creek and Harberts Creek.

WASTE CHARACTERISTICS

The hazardous waste quantity factor value for the surface water migration pathway was assigned based on the following values: (1) the surface areas of the Gate 19 Landfill, the Abandoned Landfill, the Burning Area for Explosive Residue, the Sewage Sludge Application Areas, the Gator Z Mine Test Area, and the Building 305 Temporary Waste Storage Area; and (2) volume of the Solvent Disposal Pits associated with Buildings 279, 602, and 617. Polychlorinated biphenyls (PCB) were used to determine the toxicity/persistence/bioaccumulation and ecotoxicity/persistence/ bioaccumulation factor values for the surface water pathway. A PCB (Aroclor 1260) was detected in a soil sample collected from the Building 305 Temporary Waste Storage Area.

GROUNDWATER MIGRATION PATHWAY

Groundwater sample analytical results are available for four of the eight JPG sources evaluated. At these four sources, contamination of groundwater has been documented. Hazardous substances found

in the groundwater include heavy metals, volatile organic compounds (VOC), and semivolatile organic compounds (SVOC). However, groundwater is not used as a source of drinking water within a 4-mile radius of JPG, so the hazardous substances detected in the groundwater are used only to characterize the sources evaluated. No scoresheets for the groundwater migration pathway are included herein.

SURFACE WATER MIGRATION PATHWAY

Three major stream sampling events were conducted at JPG by the U.S. Army Environmental Hygiene Agency (USAEHA) in 1992 and 1993. Analytical results from the third round of stream sampling, which was conducted in July 1993, document an observed release of mercury and silver from JPG sources to Harberts Creek. Additional sediment sampling in Harberts Creek conducted in June 1993 as part of a remedial investigation (RI) provided analytical results documenting an observed release of copper and silver to Harberts Creek.

Both mercury and silver were found in a sample of effluent (STP-1), which discharges directly to Harberts Creek. The outfall is permitted but is not monitored for heavy metals. The effluent sample analytical results document an observed release of mercury and silver to surface from the STP to surface water. Because the effluent sample was collected at the point of STP effluent discharge to Harberts Creek, no background sample analytical results are needed to support this conclusion.

Concentrations of silver detected in surface water and sediment samples collected from location EX-1, which is about 500 feet downstream of the STP outfall to Harberts Creek, establish an observed release to surface water when compared to silver concentrations detected in a sample from upstream location EX-1D. Sample EX-1D represents background conditions in Harberts Creek upstream of the STP outfall.

During the 1993 RI, two locations 50 and 100 feet upstream of the STP outfall to Harberts Creek were sampled, as were three locations 50, 100, and 150 feet downstream of the outfall. The concentration of copper below the outfall was found to be more than three times those found at either of the background locations.

All three metals detected in Harberts Creek have also been detected at elevated concentrations in soils at the STP and the Sewage Sludge Application Areas; therefore, these metals can be attributed to the site. In addition, Harberts Creek originates on site, and therefore no off-site sources could have contributed to the contamination found in the creek.

Surface water runoff and drainage from the eight sources evaluated flow into either Middle Fork Creek or Harberts Creek. Middle Fork Creek and Harberts Creek have flow rates of 50 and 13 cubic feet per second (cfs), respectively. Both creeks flow into Big Creek within the 15-mile surface water target distance limit (TDL). No surface water intakes are present within the TDL. Recreational fishing occurs in Middle Fork Creek and to a lesser extent in Harberts Creek.

The Indiana bat is known to be present at the JPG site and is likely to be present along the banks of Middle Fork Creek and Harberts Creek. In addition, four other federally listed and 22 state-listed endangered species are known to be present at JPG. About 10.36 miles of wetland frontage lies along the surface water migration pathway within the TDL: 0.96 mile along Middle Fork Creek, 1.6 miles along Harberts Creek, and 7.8 miles along Big Creek.

SOIL EXPOSURE PATHWAY

Sample analytical results document surface soil contamination at the site. However, targets for the soil exposure pathway are limited to occasional site workers, and access to the entire site is controlled by fencing and security guards. JPG is scheduled for closure, but currently 367 people work on site, and six on-site residences along Officer Quarter Road are occupied. The area of documented surficial contamination nearest these residences is the Gator Z Mine Test Area, which is located between ½ and ¾ mile away. Although a state-listed endangered species, the bobcat, has been observed at JPG, its presence has not been documented within any of on-site areas of observed contamination. No scoresheets for the soil exposure pathway are included herein.

AIR MIGRATION PATHWAY

Although JPG has conducted open burning and incineration on site, the air migration pathway was not evaluated because of insufficient data. No air sample analytical data were found to document an observed release of hazardous substances from the site to air. In addition, the air migration potential for contaminants is low because of the small quantity of volatile contaminants present on site. A particulate migration potential exists, but this potential is low because of limited particulate mobility and because moderate to heavy vegetation covers many parts of the site. Moreover, JPG is undergoing closure, and operations that could result in releases of hazardous substances to air are being reduced. No scoresheets for the air migration pathway are included therein.

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

WORKSHEET FOR COMPUTING PRELIMINARY HRS SITE SCORE

		Pathway Score (S)	Pathway Score Squared (S^2)
1.	Groundwater Migration Pathway Score (S_{gw})	NI	NI
2a.	Surface Water Overland/Flood Migration Component (S_{of})	57.61	3,319
2b.	Groundwater to Surface Water Migration Component (S_{gs})	NE	NE
2c.	Surface Water Migration Pathway Score (S_{sw}) (Enter the larger of lines 2a and 2b.)	NI	NI
3.	Soil Exposure Pathway Score (S_s)	NI	NI
4.	Air Migration Pathway Score (S_a)	NI	NI
5.	$S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$		3,319
6.	**HRS Site Score** (Divide the value on line 5 by 4.0 and take the square root.)		28.8

NI = Score not included because available information suggests that the pathway contributes little to the overall site score
NE = Not evaluated

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SOURCE CHARACTERIZATION WORKSHEET

Source 1: Gate 19 Landfill

A. Source Dimensions and Hazardous Waste Quantity

Hazardous Constituent Quantity: Unknown

Hazardous Waste Stream Quantity: 1,000 gallons (Trichloroethene)

Volume: Unknown

Area: 522,720 square feet (12 acres)

Area of Observed Contamination: NE

B. Hazardous Substances Associated with the Source

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
Benzene	Yes	No	Yes	Yes	Yes	Yes	Yes
Chloroform	Yes	No	Yes	Yes	Yes	Yes	Yes
1,1-Dichloroethene	Yes	No	Yes	Yes	Yes	Yes	Yes
Methylene chloride	Yes	No	Yes	Yes	Yes	Yes	Yes
Trichloroethane	Yes	No	Yes	Yes	Yes	Yes	Yes
Trichloroethene	Yes	No	Yes	Yes	Yes	Yes	Yes
Trichlorofluoromethane	Yes	No	Yes	Yes	Yes	Yes	Yes
Toluene	Yes	No	Yes	Yes	Yes	Yes	Yes
1,3,5-Trinitrobenzene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Acenaphthene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Anthracene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3,4-Benzofluoranthene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Benzo(a)anthracene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chrysene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fluorene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Phenanthrene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arsenic	No	Yes	Yes	Yes	Yes	Yes	Yes
Asbestos	No	Yes	Yes	Yes	Yes	Yes	Yes

SOURCE CHARACTERIZATION WORKSHEET

Source 1: Gate 19 Landfill

B. Hazardous Substances Associated with the Source (Continued)

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
Barium	No	Yes	Yes	Yes	Yes	Yes	Yes
Beryllium	No	Yes	Yes	Yes	Yes	Yes	Yes
Copper	No	Yes	Yes	Yes	Yes	Yes	Yes
Lead	No	Yes	Yes	Yes	Yes	Yes	Yes
Mercury	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Silver	No	Yes	Yes	Yes	Yes	Yes	Yes
Zinc	No	Yes	Yes	Yes	Yes	Yes	Yes

NE = Not evaluated

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SOURCE CHARACTERIZATION WORKSHEET

Source 2: Abandoned Landfill

A. Source Dimensions and Hazardous Waste Quantity

Hazardous Constituent Quantity: Unknown
Hazardous Waste Stream Quantity: Unknown
Volume: Unknown
Area: 43,560 square feet (1 acre)
Area of Observed Contamination: NE

B. Hazardous Substances Associated with the Source

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
Acetone	Yes	No	Yes	Yes	Yes	Yes	Yes
Trichloroethene	Yes	No	Yes	Yes	Yes	Yes	Yes
Benzyl alcohol	Yes	No	Yes	Yes	Yes	Yes	Yes
Dimethyl phthalate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Di-n-butyl phthalate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1,2,4-Trinitrobenzene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barium	No	Yes	Yes	Yes	Yes	Yes	Yes
Copper	No	Yes	Yes	Yes	Yes	Yes	Yes
Lead	No	Yes	Yes	Yes	Yes	Yes	Yes
Nickel	No	Yes	Yes	Yes	Yes	Yes	Yes
Silver	No	Yes	Yes	Yes	Yes	Yes	Yes
Zinc	No	Yes	Yes	Yes	Yes	Yes	Yes

NE = Not evaluated

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SOURCE CHARACTERIZATION WORKSHEET

Source 3: Burning Area for Explosive Residue

A. Source Dimensions and Hazardous Waste Quantity

Hazardous Constituent Quantity: Unknown
Hazardous Waste Stream Quantity: Unknown
Volume: Unknown
Area: 40,000 square feet
Area of Observed Contamination: NE

B. Hazardous Substances Associated with the Source

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
2,4-Dinitrotoluene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2,6-Dinitrotoluene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Di-n-butylphthalate	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trinitrotoluene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HMX	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2,4,5-TD	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2,4-D	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barium	No	Yes	Yes	Yes	Yes	Yes	Yes
Copper	No	Yes	Yes	Yes	Yes	Yes	Yes
Lead	No	Yes	Yes	Yes	Yes	Yes	Yes
Manganese	No	Yes	Yes	Yes	Yes	Yes	Yes
Mercury	Yes	Yes	Yes	Yes	Yes	Yes	Yes

NE = Not evaluated

SOURCE CHARACTERIZATION WORKSHEET

Source 4: Sewage Treatment Plant (Effluent)

A. Source Dimensions and Hazardous Waste Quantity

Hazardous Constituent Quantity: Unknown
Hazardous Waste Stream Quantity: Unknown
Volume: Unknown
Area: Unknown
Area of Observed Contamination: NE

B. Hazardous Substances Associated with the Source

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
Dichlorodiphenyl dichloroethane	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Copper	No	Yes	Yes	Yes	Yes	Yes	Yes
Mercury	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Silver	No	Yes	Yes	Yes	Yes	Yes	Yes

NE = Not evaluated

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SOURCE CHARACTERIZATION WORKSHEET

Source 5: Sewage Sludge Application Areas

A. Source Dimensions and Hazardous Waste Quantity

Hazardous Constituent Quantity: Unknown
Hazardous Waste Stream Quantity: Unknown
Volume: Unknown
Area: 46,500 square feet
Area of Observed Contamination: NE

B. Hazardous Substances Associated with the Source

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
Cyanide	No	Yes	Yes	Yes	Yes	Yes	Yes
Pesticides	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barium	No	Yes	Yes	Yes	Yes	Yes	Yes
Cobalt	No	Yes	Yes	Yes	Yes	Yes	Yes
Copper	No	Yes	Yes	Yes	Yes	Yes	Yes
Lead	No	Yes	Yes	Yes	Yes	Yes	Yes
Mercury	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Silver	No	Yes	Yes	Yes	Yes	Yes	Yes

NE = Not evaluated

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SOURCE CHARACTERIZATION WORKSHEET

Source 6: Solvent Disposal Pits Associated with Buildings 279, 602, and 617

A. Source Dimensions and Hazardous Waste Quantity

Hazardous Constituent Quantity: Unknown

Hazardous Waste Stream Quantity: 500 gallons x 3 pits = 1,500 gallons (Trichloroethene)

Volume: 2.4 cubic yards (63.6 cubic feet)

Area: Unknown

Area of Observed Contamination: NE

B. Hazardous Substances Associated with the Source

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
Acetone	Yes	No	Yes	Yes	Yes	Yes	Yes
Benzene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chloroform	Yes	No	Yes	Yes	Yes	Yes	Yes
1,1-Dichloroethane	Yes	No	Yes	Yes	Yes	Yes	Yes
1,2-Dichloroethane	Yes	No	Yes	Yes	Yes	Yes	Yes
1,1-Dichloroethene	Yes	No	Yes	Yes	Yes	Yes	Yes
1,2-Dichloroethene	Yes	No	Yes	Yes	Yes	Yes	Yes
Hexane	Yes	No	Yes	Yes	Yes	Yes	Yes
Toluene	Yes	No	Yes	Yes	Yes	Yes	Yes
Trichloroethene	Yes	No	Yes	Yes	Yes	Yes	Yes
1,1,1-Trichloroethane	Yes	No	Yes	Yes	Yes	Yes	Yes
1,1,2-Trichloroethane	Yes	No	Yes	Yes	Yes	Yes	Yes
Trichlorofluoromethane	Yes	No	Yes	Yes	Yes	Yes	Yes

NE = Not evaluated

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SOURCE CHARACTERIZATION WORKSHEET

Source 7: Gator Z Mine Test Area

A. Source Dimensions and Hazardous Waste Quantity

Hazardous Constituent Quantity: Unknown
Hazardous Waste Stream Quantity: Unknown
Volume: Unknown
Area: 1,980,000 square feet (220,000 square yards)
Area of Observed Contamination: NE

B. Hazardous Substances Associated with the Source

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
Barium	No	Yes	Yes	Yes	Yes	Yes	Yes
Chromium	No	Yes	Yes	Yes	Yes	Yes	Yes
Copper	No	Yes	Yes	Yes	Yes	Yes	Yes
Lead	No	Yes	Yes	Yes	Yes	Yes	Yes
Mercury	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nickel	No	Yes	Yes	Yes	Yes	Yes	Yes
Silver	No	Yes	Yes	Yes	Yes	Yes	Yes

NE = Not evaluated

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SOURCE CHARACTERIZATION WORKSHEET

Source 8: Building 305 Temporary Waste Storage Area

A. Source Dimensions and Hazardous Waste Quantity

Hazardous Constituent Quantity: Unknown
Hazardous Waste Stream Quantity: Unknown
Volume: NE
Area: 750 square feet
Area of Observed Contamination: NE

B. Hazardous Substances Associated with the Source

Hazardous Substance	Available to Pathway						
	Air		Ground-water (GW)	Surface Water (SW)		Soil	
	Gas	Particulate		Overland/ Flood	GW to SW	Resident	Nearby
Trichloroethene	Yes	No	Yes	Yes	Yes	Yes	Yes
PCB (Aroclor-1260)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Benzo(a)anthracene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Benzo(k)fluoranthane	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chrysene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fluoranthene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fluorene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pyrene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Phenanthrene	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Asbestos	No	Yes	Yes	Yes	Yes	Yes	Yes
Arsenic	No	Yes	Yes	Yes	Yes	Yes	Yes
Barium	No	Yes	Yes	Yes	Yes	Yes	Yes
Copper	No	Yes	Yes	Yes	Yes	Yes	Yes
Lead	No	Yes	Yes	Yes	Yes	Yes	Yes
Mercury	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Silver	No	Yes	Yes	Yes	Yes	Yes	Yes
Zinc	No	Yes	Yes	Yes	Yes	Yes	Yes

NE = Not evaluated

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SURFACE WATER PATHWAY SUMMARY

Comments	References
• Analytical results for STP effluent samples collected in July 1993 during USAEHA's third round of stream sampling at JPG document an observed release of mercury and silver to Harberts Creek. An observed release of copper and silver to surface water is documented by analytical results for surface water and sediment samples collected in Harberts Creek during the 1993 RI.	4 and 5
• The toxicity/persistence factor value is based on PCBs and lead, both of which have a toxicity factor value of 10,000 and a persistence factor value of 1.0. A PCB was detected in surface soil samples from the Building 305 Temporary Waste Storage Area, and lead was detected in environmental samples collected from seven of the eight sources evaluated.	8
• The hazardous waste quantity (HWQ) values assigned to the sources evaluated are as follows: Source 1 HWQ = 153.74, Source 2 HWQ = 12.81, Source 3 HWQ = 1.18, Source 4 HWQ = unknown, Source 5 HWQ = 172.22, Source 6 HWQ = 25.2, Source 7 HWQ = 58.24, and Source 8 HWQ = 0.022. These values, which total 423.41, were calculated based on Table 2.5 of the HRS Final Rule. Therefore, an HWQ factor value of 100 was assigned Table 2.6 of the HRS Final Rule.	4 and 7
• A waste characteristics factor value of 32 was assigned per Table 2.7 of the HRS Final Rule based on a toxicity/persistence factor value of 10,000 and an HWQ factor value of 100.	7
• No drinking water intakes are present within the 15-mile surface water TDL; therefore, a nearest intake factor value of 0 and a population factor value of 0 were assigned per Section 4.1.2.3.1 of the HRS Final Rule.	1 and 7
• Surface water is used for watering livestock; therefore, a surface water resource category factor value of 5 was assigned per Section 4.1.2.3.3 of the HRS Final Rule.	2, 4, and 7

• The toxicity/persistence/bioaccumulation factor values are based on PCBs, mercury, and 3,4-benzofluoranthene, all of which have a toxicity factor value of 10,000; a persistence factor value of 1.0; and a food chain bioaccumulation factor value of 50,000. All four of these hazardous substances were detected in environmental samples collected from sources evaluated.	4 and 9
• The flow rates of Harberts Creek and Middle Fork Creek are 13 and 50 cfs, respectively. Based on the description in Ref. 9, it was assumed that Big Creek is consistent with a range of flow rate from 10 to 100 cfs. Therefore, a surface water dilution value of 0.1 was assigned to Harberts Creek, Middle Fork Creek, and Big Creek per Table 4.13 of the HRS Final Rule.	4, 7, and 9
• Because an observed release of a hazardous substance (mercury) with a bioaccumulation factor value of 500 or greater has been documented, and because a downstream fishery is present in Harberts Creek, a food chain individual factor value of 20 was assigned per Section 4.1.3.3.1 of the HRS Final Rule.	5 and 7
• Fishing occurs in Harberts Creek downstream of the site and in Middle Fork Creek and Big Creek. Although no estimate of recreational fishery production within the surface water TDL is available, fishery production is assumed to be greater than 0 pounds per year. Therefore, for each fishery, a human food chain population value of 0.03 was assigned based on Table 4.18 of the HRS Final Rule. A human food chain population factor value of 0.0009 was assigned per Section 4.1.3.3.2.3 of the HRS Final Rule.	4, 7, and 9
• The ecosystem toxicity/persistence/bioaccumulation factor values are based on PCBs, mercury, benzo(a)pyrene, and 3,4-benzofluoranthene, all of which have an ecosystem toxicity factor value of 10,000; a persistence factor value of 1.0; and an ecosystem bioaccumulation factor value of 50,000.	4 and 8
• About 10.36 miles of wetland frontage is present within the surface water TDL and is subject to potential contamination. About 0.96 mile of wetland frontage is present along Middle Fork Creek; about 1.6 miles of wetland frontage is present along Harberts Creek; and about 7.8 miles of wetland frontage is present along Big Creek. A wetland rating value of 250 was assigned for these three creeks per Table 4.24 of the HRS Final Rule.	6 and 7

• The banks of Middle Fork Creek and Harberts Creek are possible habitats for the Indiana bat, which is a federally listed endangered species. The bald eagle, a federally listed endangered species, has been observed at JPG near Krueger Lake (in the cantonment area) and Old Timber Lake. Five state-listed endangered species are present or potentially present at JPG: Kirtland's snake, the northern harrier, the bobcat, the northern red salamander and the Maryland meadow beauty. Therefore, a sensitive environments rating value of 400 was assigned per Table 4.23 of the HRS Final Rule.	3 and 7
• A potential sensitive environments threat factor value of 13.87 was assigned per Section 4.1.4.3.1.3 of the HRS Final Rule.	7

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

	Factor Categories and Factors	Maximum Value	Value Assigned	
	Drinking Water Threat			
	Likelihood of Release			
1.	Observed Release	550	550	
2.	Potential to Release by Overland Flow			
	2a. Containment	10	0	
	2b. Runoff	25	0	
	2c. Distance to Surface Water	25	0	
	2d. Potential to Release by Overland Flow [lines 2a x (2b + 2c)]	500	0	
3.	Potential to Release by Flood			
	3a. Flood Containment	10	0	
	3b. Flood Frequency	50	0	
	3c. Potential to Release by Flood [lines 3a x 3b]	500	0	
4.	Potential to Release [lines 2d + 3c]	500	0	
5.	Likelihood of Release [higher of lines 1 and 4]	550		550
	Waste Characteristics			
6.	Toxicity/Persistence	a	10,000	
7.	Hazardous Waste Quantity	a	100	
8.	Waste Characteristics	100		32
	Targets			
9.	Nearest Intake	50	0	
10.	Population			
	10a. Level I Concentrations	b	0	
	10b. Level II Concentrations	b	0	
	10c. Potential Contamination	b	0	
	10d. Population [lines 10a + 10b + 10c]	b	0	
11.	Resources	5	5	
12.	Targets [lines 9 + 10d + 11]	b		5
13.	**Drinking Water Threat Score** [lines (5 x 8 x 12)/82,500][c]	500		1.07

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET
(Continued)

	Factor Categories and Factors	Maximum Value	Value Assigned	
	Human Food Chain Threat			
	Likelihood of Release			
14.	Likelihood of Release [same value as line 5]	550		550
	Waste Characteristics			
15.	Toxicity/Persistence/Bioaccumulation	a	5×10^8	
16.	Hazardous Waste Quantity	a	100	
17.	Waste Characteristics	1,000		320
	Targets			
18.	Food Chain Individual	50	20	
19.	Population			
	19a. Level I Concentrations	b	0	
	19b. Level II Concentrations	b	0	
	19c. Potential Contamination	b	0	
	19d. Population [lines 19a + 19b + 19c]	b	0.0009	
20.	Targets [lines 18 + 19d]	b		20.0009
21.	**Human Food Chain Threat Score** [lines (14 x 17 x 20)/82,500][c]	100		42.67

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not ~~round~~ to nearest integer

U.S. Army Jefferson Proving Ground
Madison, Indiana
IN5 210 020 454

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET
(Continued)

	Factor Categories and Factors	Maximum Value	Value Assigned	
	Environmental Threat			
	Likelihood of Release			
22.	Likelihood of Release [same value as line 5]	550		550
	Waste Characteristics			
23.	Ecosystem Toxicity/Persistence/ Bioaccumulation	a	5×10^8	
24.	Hazardous Waste Quantity	a	100	
25.	Waste Characteristics	1,000		320
	Targets			
26.	Sensitive Environments			
	26a. Level I Concentrations	b	0	
	26b. Level II Concentrations	b	0	
	26c. Potential Contamination	b	6.5	
27.	Targets [lines 26a + 26b + 26c]	b		6.5
28.	**Environmental Threat Score** [lines (22 x 25 x 27)/82,500]	60		13.87
	Surface Overland/Flood Migration Component Score for a Watershed			
29.	Watershed Score [lines 13 + 21 + 28][c]	100		57.61
30.	**Surface Water Overland/Flood Migration Component Score (S_{of})** [highest score from line 29 for all watersheds evaluated][c]	100		57.61

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

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1. Advanced Sciences, Inc. 1993. "Revised Preliminary Site Inspection Report." August.

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5. USAEHA. 1993. "Third Round of Stream Sampling and Analysis." Wastewater Management Study No. 32-24-H1CE-93. July 19-28.

6. U.S. Department of the Interior. 1989. National Wetlands Inventory Maps of City Falls, San Jacinto, Vernon, and Volga, Indiana. Fish and Wildlife Service.

7. U.S. Environmental Protection Agency. (EPA). 1990. Hazard Ranking System Final Rule. *55 Federal Register* 51583. December 14.

8. EPA. 1994. Superfund Chemical Data Matrix. June 30.

9. U.S. Fish and Wildlife Service. 1994. "JPG Fish and Wildlife Management Plan." September.